WORKSHOP ON
ENERGY POLICY ISSUES

December 19-20, 1986

Conducted by

TATA ENERGY RESEARCH INSTITUTE
NEW DELHI

Timetable for
WORKSHOP ON ENERGY POLICY ISSUES

at Rambagh Palace Hotel, JAIPUR
December 19-20, 1986

December 19

10.00 - 11.00	**Inaugural Session** (Hon'ble Shri Vasant Sathe would inaugurate; Hon'ble Shri Harideo Joshi would be the Chief Guest; Shri M.M. Kohli would preside)
10.00 - 10.05	Welcome Remarks - Dr. R.K. Pachauri, Director, Tata Energy Research Institute.
10.05 - 10.15	Presidential Remarks - Shri M.M. Kohli, Secretary, Department of Power, Government of India.
10.15 - 10.20	Remarks by Dr. V.L. Kelkar, Adviser (EP&P), Department of Petroleum & Natural Gas, Government of India
10.20 - 10.30	Address by Chief Guest - Hon'ble Shri Harideo Joshi, Chief Minister of Rajasthan
10.30 - 10.55	Inaugural Address - Hon'ble Shri Vasant Sathe, Minister of Energy, Government of India
10.55 - 11.00	Vote of Thanks - Dr. R.K. Pachauri
11.00 - 11.30	Tea/Coffee
11.30 - 12.30	**Technical Session:** Policy Issues in Promoting Energy Efficiency
	Chairman: Dr. Y.K. Alagh
	Co-Chairman: Mrs. Shailaja Chandra
11.30 - 11.50	Energy Efficiency in the Indian Economy - Dr.R.K. Pachauri & Mrs. Leena Srivastava
11.50 - 12.10	Industrial Energy Policies: National and International Scene - Mr. G. Sambasivan
12.10 - 12.30	Discussion
12.30 - 13.20	**Technical Session:** Efficient Use of Power in Electric Motors
	Chairman: Mr. B.S. Samat
	Co-Chairman: Mr. Prabir Sengupta
12.30 - 12.50	Strategies For Improving Efficiency Of Electric Motors In Industry and Agriculture - Mr. Virendra Kothari
12.50 - 13.20	Discussion
13.20 - 14.30	Lunch
	Luncheon Session: Energy Efficiency in the Developing Countries
	Chairman: Mr. Takashi Niikura
13.50 - 14.30	Luncheon Talk: Energy Efficiency ~~in the Developing~~ Countries - Mr. Ian M. Hume

14.35 - 15.15	**Technical Session:** Energy Efficiency in Lighting
	Chairman: Mr. P.R. Latey
	Co-Chairman: Mr. S.K. Aggarwal
14.35 - 14.55	Potential for Higher Energy Efficiency in Lighting - Dr. Ashok Gadgil
14.55 - 15.15	Discussion
15.15 - 15.35	Tea/Coffee
15.35 - 17.00	**Panel Discussion:** Policies for Promoting Energy Efficiency in Industry & Agriculture
	Chairman: Mr. P.S. Jha
	Panelists: Dr. Y.K. Alagh Mrs. Shailaja Chandra Mr. V. Kothari Mr. R. Raghuraman Mr. Prabir Sengupta Mr. K.N. Venkatasubramanian
19.00 - 21.00	Reception & Dinner

December 20

09.30 - 10.15	**Technical Session:** Energy Conservation in Japan
	Chairman: Mr. T.N. Seshan
	Co-Chairman: Mr. K.R. Paramesvar
09.30 - 09.50	Energy Efficiency in Japan - Mr. Takashi Niikura
09.50 - 10.15	Discussion
10.15 - 11.00	**Technical Session:** Energy Conservation in Europe
	Chairman: Mr. Bahadur Chand
	Co-Chairman: Mr. B.L. Sharma
10.15 - 10.35	Energy Conservation Policies in the EEC - H.E. Mr. M. Macioti
10.35 - 11.00	Discussion
11.00 - 11.20	Tea/Coffee
11.20 - 12.20	**Technical Session:** Conservation of Fossil Fuels
	Chairman: Dr. V.L. Kelkar
	Co-Chairman: Mr. A.C. Kapadia
11.20 - 11.40	Petroleum Conservation in India: Problems and Prospects - Mr. Kapil Thukral & Dr. R.K. Pachauri

11.40 - 12.00	Beneficiation of Non-cooking Coal for Power Houses - Mr. P.V. Sridharan & Dr. Ajay Mathur
12.00 - 12.20	Discussion
12.20 - 13.30	**Panel Discussion:** Energy Efficiency in the Transport & Household Sectors Chairman: Mrs. Otima Bordia Panelists: Mr. S.K. Aggarwal Dr. Ashok Gadgil Mr. P.K. Goel Mr. A.C. Kapadia
13.30 - 14.30	Lunch
14.30 - 15.30	**Recommendations of the Workshop** Chairman: Mr. Lovraj Kumar Panelists: Dr. J. Gururaja Mr. Ian M. Hume Dr. V.L. Kelkar Dr. R.K. Pachauri Mr. K.R. Paramesvar Dr. S. Ramesh
15.30 - 15.45	Tea/Coffee
15.45 - 16.30	**Valedictory Session:** (Valedictory Address by Shri Hiten Bhaya; Mr. D.S. Seth will preside).
15.45 - 15.55	Remarks by Mr.D.S. Seth, Chairman, Governing Council, TERI.
15.55 - 16.25	Valedictory Address by Shri Hiten Bhaya, Member, Planning Commission, Government of India.
16.25 - 16.30	Vote of thanks - Dr. R.K. Pachauri

Workshop on
ENERGY POLICY ISSUES
at
Rambagh Palace Hotel, JAIPUR
December 19-20, 1986

List of Participants

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PARTICIPANTS FROM TERI

1. Dr. R.K. Pachauri
2. Dr. S. Ramesh
3. Dr. Ashok Gadgil
4. Mr. Virendra Kothari
5. Mr. P.V. Sridharan
6. Mr. G. Sambasivan
7. Mr. Kapil Thukral
8. Mrs. Leena Srivastava
9. Dr. Ajay Mathur

Administrative Arrangements

Mr. K.S.Subramanian, Executive Officer, TERI.

ENERGY EFFICIENCY IN THE INDIAN ECONOMY

By

R.K. Pachauri
Leena Srivastava

Paper presented at the
WORKSHOP ON ENERGY POLICY ISSUES
held on 19th & 20th December 1986
Jaipur, India

The demand for energy in India has been growing rapidly, and consequently investments in the energy sector over the past three Five Year Plans have been taking up almost 1/3rd of the total public sector outlay. Given the challenge of achieving a steady growth of 5% or above in the Indian economy the rate of growth in demand for energy would continue at a high level if no major policy interventions or changes are brought about. The recent exercises carried out by the Screening Group on Demand Forecasting set up by the Planning Commission has reviewed the "requirements" for energy upto the year 2004-05 and has come up with projections which pose a staggering task in terms of arranging for adequate energy supplies of various forms. The work of this screening group is based essentially on exercises carried out recently by other Government bodies, notably the Advisory Board on Energy.

To provide an indication of the size of future energy demand it may be pertinent to quote just a few figures for demand in 1984-85 vs. projections for 2004-05 as given below.

DEMAND FOR ENERGY

	1984-85	2004-05
Total generation of electricity (Billion Kwhr)	167.45	818.83
Coal (million tonnes)	139.93	576.00
Petroleum Products (million tonnes)	38.75	112.51-123.11
Fuelwood (million tonnes)	146.50	258.90
Dung Cake (million tonnes)	80.30	150.53
Crop Wastes (million tonnes)	45.10	77.00

Even a cursory glance at these figures shows the immense flow of investments that would be required in the next 18 years or so if supplies are to match the requirements estimated above. Quite apart from the increasing capital intensity of the energy sector there is the danger of a growing dependence on imported oil which would pose an unusually high burden in terms of foreign exchange outflows if demand materialises to the levels indicated by these figures.

The time is right for studying the very nature of demand for energy and exploring means by which the growth in demand can be suppressed without sacrificing economic growth. A comprehensive study of this subject would go into questions of the structure of the economy, the most immediate challenge being to reduce energy

demand for a given economic structure. While in the material circulated for this workshop and in available literature various success stories are evident of strong and fruitful energy conservation efforts in the developed countries, very little has been written on this subject dealing with the developing countries. It would, therefore, be useful to see, at least in broad terms the position of India with respect to some other nations of Asia. In a recent publication by Sathaye[4], which was written on the basis of a project jointly executed by the Institute of Nuclear Energy Technology in China, the Tata Energy Research Institute and the Lawrence Berkeley Laboratory in the USA, with support from ESCAP, energy intensities for different countries of Asia have been computed. Table 1 below shows the change in energy demand per capita for the selected countries reviewed in this publication.

Table 1

Energy Consumption per Capita

	1973	1983	AACR
Bangladesh	-	39	-
China	304	446	3.8%
India	130	180	3.3%
Indonesia	86	184	7.6%
Korea	644	1185	6.1%
Malaysia	439	741	5.2%
Pakistan	90	179	6.9%
Philippines	272	261	-0.4%
Taiwan	910	1625	5.8%
Thailand	216	289	2.9%
Average	231	338	3.8%

While per capita energy consumption in India has been one of the lowest ranking 7 in the 10 countries listed above the energy use per unit of GDP (Table 2) ranks second in the same group of countries. This is a rough indicator that India is not as efficient a user of energy as some of the other countries of Asia.

Table 2

Energy Demand and GDP
(TOE per 1980 US$)

	1973	1983	AAGR
Bangladesh	-	258	-
China	1607	1480	-0.8%
India	677	778	1.4%
Indonesia	246	349	3.5%
Korea	608	629	0.3%
Malaysia	344	387	1.2%
Pakistan	404	634	4.5%
Philippines	467	354	-2.8%
Taiwan	605	649	0.7%
Thailand	415	367	-1.2%
Average	**911**	**910**	-

Again even though the energy GDP ratio has changed only at a rate of 1.4% per annum, this appears large in relation to the experience of countries like Philippines and Thailand which have shown an actual decline in the energy-GDP ratio and Taiwan as well as the Republic of Korea and Malaysia which have shown lower rates of growth than India. Fortunately, energy use in India is not as intensive as in China. This is particularly true of the industrial sector as shown in Table 3.

Table 3

Industrial Energy Intensity
(TOE per 1980 US$ of Value Added)

	1978	1983	AAGR
Bangladesh	402	326	-4.2%
China	2435*	2335	-1.4%
India	733	881	3.7%
Indonesia	247	369	8.1%
Korea	453	448	-0.2%
Malaysia	333	331	-0.1%
Pakistan	623	558	-2.2%
Philippines	394	297	-5.7%
Taiwan	517	459	-2.4%
Thailand	282	228	-4.2%
Average	488	506	0.7

* 1980

The figures for India viewed in absolute terms show unfavourably with the sole exception of China. For instance, industrial energy intensity in Korea is much lower than that of India despite the rapid industrialisation that has taken place in that country. A recent World Bank's report(5) contends that category A savings in industrial energy consumption, which include small

investments in implementing combustion efficiency improvements, and other housekeeping measures generally, have payback periods of between 10 and 20 months. Even Category B savings, which generally require larger investments in retrofitting existing plants, waste heat recovery systems, etc., yield paybacks in two to five years. The almost complete absence of investments in higher industrial energy efficiency in India has been due to an unsustainable emphasis on energy production capacity. This has led not only to a lack of attention to efficient energy use in the past, but has also brought about imbalances in investments in power transmission and distribution facilities, and in measures for reducing refinery losses.

In the transport sector, data limitations did not permit a comparison of energy use per unit of output in terms of freight tonne kilometres or passenger kilometres, but the trend in the use of gasoline and diesel per motor vehicle is brought out for the countries covered in Table 4.

Table 4

Transportation Gasoline and Diesel Demand per Motor Vehicle (TOE)

	1978	1983	AAGR
Bangladesh	2.91	2.57	-2.5%
China	-	-	-
India	2.91	2.51	-2.9%
Indonesia	1.64	1.00	-9.8%
Korea	7.22	3.36	-15%
Malaysia	1.17	1.00	-3.2%
Pakistan	2.19	2.34	1.4%
Philippines	2.96	2.30	-5.0%
Taiwan	0.71	0.49	-7.5%
Thailand	2.63	1.59	-10%
Average	**2.07**	**1.44**	**-7.2**

Here again it is difficult to arrive at any conclusions, since the extent of usage of each vehicle and the mix of vehicles cannot be indicated. What is significant, however, is the reduction in fuel use per vehicle that is evident in the case of, say, the Republic of Korea, Taiwan, Thailand and even Indonesia, which is an oil exporting nation. This usage may not have been accompanied by any reduction in mileage per vehicle, since the countries named have experienced

steady and high rates of economic growth, and therefore in all likelihood with rising incomes the usage of vehicles is also likely to have gone up during this period.

A comparison has often been made between India and China in arriving at several aspects of economic development. It would be useful to make some comparisons in the energy field as well. In very broad terms China has exploited its hydroelectric potential much faster and to a slightly greater degree than India. The total hydel potential in China is estimated at 380 GW, whereas in India it is around 75 GW at 60% load factor. Hydel electricity production in India increased from 3.10 million TCE in 1970-71 to 6.62 million TCE in 1984-85. As against this China increased its hydel production from 9.61 million TCE to 34.25 million TCE. Growth of coal-based thermal power generation in India has been rapid in the past 15 years or so but it must be pointed out that use of coal for power generation quite apart from questions of depletion of coal resources also implies use of energy for transportation of coal and, of course, for mining. If one computes the overall energy input per kilowatt hour of thermal power produced, taking into account energy inputs in mining and transportation, the overall efficiency of conversion works out to only 26.1%. Purely in terms of efficiency of energy use, the development of hydel potential, based

entirely on a renewable form of energy acquires importance.

The pattern of energy utilisation in China and India is quite different. For instance, the transport sector in India consumes relatively high quantities of energy, amounting to approximately 31.7% of total commercial energy consumed in India in 1978-79 as compared to only 4.6% in the case of China in 1980. Also China's reliance on commercial energy is higher not only in absolute but also relative terms, with 70.4% of its total energy coming from commercial forms and only 29.6% from non-commercial or biomass energy. In the case of India the dependence on non-commercial energy is close to 40%, and this, therefore, becomes an important area for exploring possibilities of efficiency improvements far greater than in the case of China, particularly with the high social costs of deforestation resulting from use of fuelwood.

The overall energy efficiency of an economic system depends on a large variety of factors. These include primarily the structure of the economy, which undoubtedly will witness significant changes in the next few decades and, of course, the choice of technologies adopted for production and consumption of energy. Some trends in the changing shares of agriculture and

manufacturing as against shares of different major forms of energy used in the Indian economy are shown in Fig.1. It would be seen that while the demand for coal has been growing during the period covered, the demand for petroleum products has grown faster than policy requirements would dictate.

The planning of structural changes in the Indian economy is something which requires a detailed and indepth macro economic analysis, and it is hoped that such considerations will be foremost in the minds of our planners in the years to come. A country cannot achieve growth beyond the limits of its resource endowments and institutional constraints. However, what is practicable in the immediate future is the upgradation of technology and appropriate choice of new technologies in keeping with the overall financial and economic benefits which would continue with the long run rising trend of energy prices.

Amory Lovins[3] has coined a new term in the context of the growth of power consumption and refers to Nega Watts as a new form of energy as opposed to producing Mega Watts. He cites the example of US utilities that are now providing enormous incentives to customers for reducing their energy intensity on the basis that the cost of such reduced demand or Nega Watts is lower than adding capacity in the form of Mega Watts.

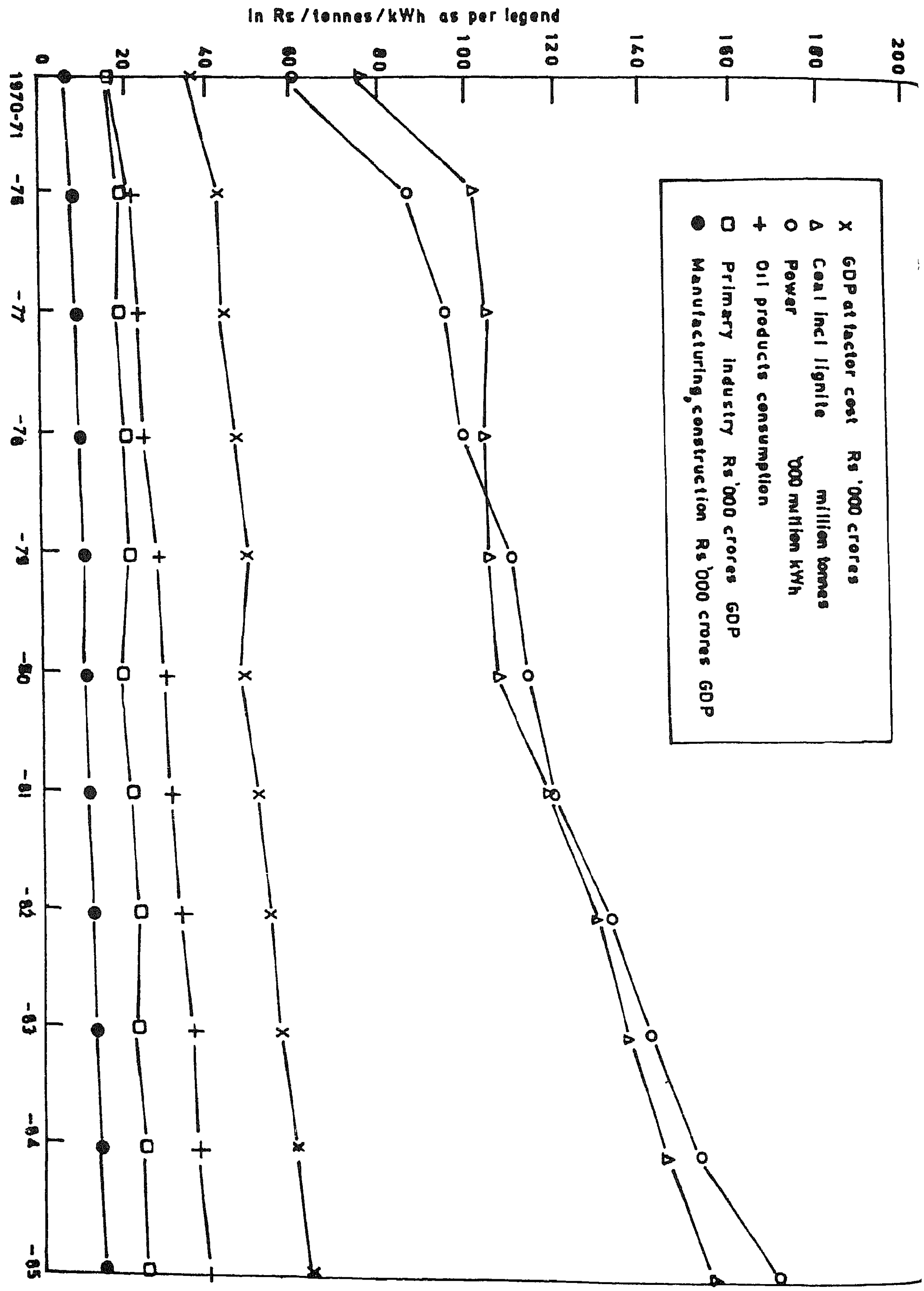
In Rs / tonnes / kWh as per legend
0
20
40
60
80
100
120
140
160
180
200
1970-71
-76
-77
-78
-79
-80
-81
-82
-83
-84
-85
x GDP at factor cost Rs '000 crores
Δ Coal incl lignite million tonnes
o Power '000 million kWh
+ Oil products consumption
□ Primary industry Rs '000 crores GDP
● Manufacturing, construction Rs '000 crores GDP

Figure 1

Some of the programmes being offered by US utilities deliver specific types of hardware to specific types of customers. However, what Lovins refers to as second generation programmes rely on merely offering financial incentives to customers for saving electricity without specifying the means for doing so. For example, Southern California Edison and Pacific Gas and Electric Company each offer rebates of several hundred dollars per kilowatt saved by their customers. Some programmes also pay for saving in kilowatt hours, the highest offered price which Lovins refers to is at a level of US$1.15 per kilowatt hour saved in the first year from any durable weatherisation improvements which displace electric resistance heating.

There is also an urgent need for taking a close look at domestic electricity using appliances which in urban areas are going to consume larger quantities of electricity and contribute substantially to peak demand. For instance, the production of domestic refrigerators in India has gone up from 65,400 in 1970 to 546,500 in 1984. In refrigerators alone very significant savings in both energy and power demand are possible. In testimony that Lovins(2) gave to the Wisconsin Utilities Commission, he gave an approximate annual kilowatt hour consumption of 16-17 cu.ft. refrigerator/freezers as follows:

Average US model sold; 1950 (manual-defrost freezer): 800
Maximum allowed under California standard, 1981: 1300
Average U.S. model sold, 1981: 1200
Best U.S. model in mass production (Whirlpool), 1985: 750
Maximum allowed under California standard passed in 1985 for 1992: 700
Best prototype by a major U.S. manufacturer (Amana, 1982-83): 684
Best Japanese model in mass production, 1984 (Matsushita): 480*
Best prototype developed for CA utilities (Danish Technical University), 1984: 453
Best achievable efficiency cited by NRDC and ESRG, 1983: 420
Best world model in mass production, 1984 (Gram, Denmark): 359**
Best U.S. model in model-shop production (Sun Frost), 1984 (semi-manual defrost): 184***
Same in Frostbelt climate with hybrid cooling fin, 1984: <100
Same with improved compressor, motor controller, and dual refrigerant (calculated): ca. 32 (further reductions are available from proprietary control improvements now under development)
Completely passive models demonstrated ca. 1982 (electricity for light): 0.5

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* This figure is a rapidly moving target: the efficiencies of the best refrigerators and freezers from the leading Japanese manufacturers are continuing to improve by about 10-20 %/y with no significant increase in real price.

** Scaled linearly from the actual size (14 cu.ft) to 16 cu.ft.

*** Under standard DOE test conditions (which include a year-round ambient temperature of 90°F) this might rise to about 240 kW-h/y, but 184 reflects actual consumption under realistic indoor conditions including actual use.

It is evident from these figures that dramatic improvements have taken place in the efficiency of electrical appliances used in the household. But we have not made any major efforts in improving the efficiency of Indian refrigerators. It would be prudent for us to go in for the most efficient technologies, since with the high rate of growth in demand for these appliances we may lose a major opportunity for energy savings in the years to come.

This paper is only directed at the limited objective of surveying the current energy scene in the country and looking at directions that could be taken in improving the efficiency of energy use. In order to implement energy efficiency measures several strategies and approaches become relevant. These include better training of major energy users, the conduct of large scale energy audits, rational pricing of energy and a system of incentives and disincentives to promote the adoption of energy efficient technologies and equipment. Undoubtedly these are measures that will be discussed in detail in this workshop, and perhaps a package could be developed on these issues, which Government, industry and society at large could pursue towards improving the efficiency of energy use in the Indian economy.

REFERENCES

1. Economic Survey 1985-86, Ministry of Finance, Government of India.

2. Lovins, Amory B., "Least-Cost Electricity Strategies for Wisconsin - Practical Opportunities to Save Over a Billion Dollars a Year", Direct Testimony before the Wisconsin Public Service Commission, Colorado, 9 September, 1985.

3. Lovins, Amory B., "Negawatts: A Practical Remedy for Megagoofs", Address to Energy Conservation Panel, 97th Annual Convention, National Association of Regulatory Utility Commissioners, New York, 20 November 1985.

4. Sathaye, Jayant and Meyers, Steven, "Energy Demand in Asian Developing Countries: Historical Trends and Future Prospects", Lawrence Berkeley Laboratory, July 1986.

5. The World Bank, "The Energy Transition in Developing Countries, Washington D.C., 1983.

INDUSTRIAL ENERGY POLICIES - NATIONAL AND INTERNATIONAL SCENE

G. SAMBASIVAN

TATA ENERGY RESEARCH INSTITUTE

NEW DELHI

WORKSHOP ON ENERGY POLICY ISSUES

JAIPUR

DECEMBER 19-20, 1986

INDUSTRIAL ENERGY POLICIES - NATIONAL AND INTERNATIONAL SCENE

Introduction

The impact of increase in oil price in 1973-74 and 1979-80 was felt more in the net-oil-importing developing countries than in the more developed countries. The onus of reconsidering or reevaluating oil consumption was greatest in the oil-importing countries due to the heavy burden of balance of payments problems.

An important approach to addressing that burden was recourse to effective conservation policies. The means and the seriousness with which these policies were formulated and implemented varied between countries. Some were swifter and more purposeful than others. The speed with which the policies were implemented depended on various factors, such as structure of industry, availability of improved technology, fuel substitution possibilities, capital availability and the official machinery.

The outstanding examples of energy conservation measures adopted were generally confined to the industrialized countries. For example, between 1973 and 1983, the total economic growth in the EEC countries was to the extent of 18 % with an actual decline of energy consumption of 6 %. In the case of Japan, the achievements have been even greater, with growth rates averaging close to 5 % since the first oil shock, and this has been accompanied by an actual decline in energy consumption.

As in other developing countries, in India the potential for energy conservation remains high, and it is virtually untapped. The industrial sector being the more organised sector, it is the prime candidate for implementation of energy conservation measures.

This paper concentrates on the current policies and policy options, and difficulties in implementation of energy conservation measures in India. The policies and programmes of a few other countries are discussed to highlight the extent to which energy conservation is carried out in these countries, and the lessons we might learn from these examples.

2. ENERGY USE PATTERN IN INDIA'S INDUSTRIAL SECTOR

The industrial sector has traditionally been the largest consuming sector of commercial energy in the Indian economy. In 1982-83, about 490 trillion kilocalories of energy was consumed by industry as purchased fuels and feedstock, which was about 43 percent of the total consumption of commercial energy in India. Coal accounted for about 69 percent, oil 19 percent and electricity 9 percent of the total energy used in industry .

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* Compiled from Annual Coal Statistics, Indian Petroleum and Petrochemical Statistics and Public Electric Supply - All India Statistics General Review.

In the case of electricity, industry consumes roughly 60 % of the total electricity generated, and the elasticity of electricity has remained much higher compared to that of developed countries. In the recent document indicating the perspective for 2004-2005, the Advisory Board on Energy has estimated electricity demand for the industrial sector at 280 billion kWh and 367 billion kWh for 1999-2000 and 2004-2005 respectively. If these estimates are to hold, then the demand for electricity in 1994-95 can be interpolated at around 185 billion kWh, showing an increase of almost 50 % during the 8th Five Year Plan period.

The demand for energy is highly sensitive to the kind of industrialisation strategies that the country pursues. If a high value-added manufacturing strategy based on low energy consumption industries is pursued, a consequent decline in the electricity elasticity would be possible.

Coal use in the industrial sector is mainly in the form of coking coal for steel industry, and non-coking coal for cement, paper and paper board, newsprint, vanaspati and brick industries. A large cluster of small industries generally accounts for around 20 % of total coal consumption.

If there was to be no improvement in the efficiency of coking coal use in the industry, then the demand in the years 1989-90, 1994-95, 1999-2000 and 2004-2005 would be 41.1, 60, 75 and 88 million tonnes respectively.

In the case of non-coking coal, efficient processes and changes in raw materials in cement, nitrogenous fertiliser, and pulp and paper industries are expected to bring about reduction in coal use.

As far as petroleum products are concerned, the industrial sector uses oil products generally at a rate of 0.004 kg per rupee of value added. If this norm was to continue unchanged, then the demand in the year 2004-2005 would be about 17 million tonnes of petroleum products.

On the basis of above projections we can predict the demand for coal and petroleum as shown in Table 1 below:

Table 1

Future Demand for Coal and Petroleum Products in Industrial Sector

Year	Requirement of Coal in Industry (Million Tonnes)	Requirement of Petroleum Products in Industry as Fuel (Million Tonnes)
1989-90	89.2	6.11
1994-95	120.0	8.53
1999-2000	150.0	11.81
2004-2005	188.0	16.62

The growth rate represented by the above figures indicates that the demand for energy in the industrial sector for coal, petroleum and electricity may not be met. Moreover, the problems and constraints in the supply industry are compounded by the transportation and other infrastructure deficiencies. Hence, energy conservation assumes an importance overriding other elements of a long-term energy policy.

3. DIFFICULTIES IN IMPLEMENTING ENERGY CONSERVATION MEASURES

In India the industrial sector is relatively organised and yet highly disparate and dispersed, consisting of a large number of small manufacturing firms. Moreover, the units are of various vintage, using outdated technologies, and in many cases running beyond the design-life of the plant.

The Indian industries have some of the highest energy intensities vis-a-vis developed and developing countries. Though there is a large scope for improvement, there are some important reasons for the energy intensities remaining high. These are discussed below:

First, most industries have little incentive to improve their energy consumption rate, as the energy cost forms only a small percentage of the total product cost.

Secondly, in the energy-intensive industries such as steel, aluminium, cement and petroleum refining, there are very few companies, which are essentially oligopolies. Therefore, increased energy costs are easily passed on to the consumers. Even if there are administered prices for their products, lack of profit-motive generally discourages energy conservation. In these large (public sector) undertakings there is little incentive to cut production costs under these conditions.

Thirdly, major conservation efforts require replacement of capital stock, process modifications, retrofits and technology changes, which normally require large investments. Due to paucity of funds, high interest rates, and high demand for industrial goods the industries generally prefer investing in capacity expansion rather than in energy conservation equipment. Often this means installation of cheap machines, and outdated technology and production systems, which leads to energy inefficiency.

Finally, shortage of raw materials, capacity under-utilisation, interruption in fuel and electricity supply, lack of commitment to energy conservation, labour unrest, lack of trained manpower, lack of instrumentation, and absence of good housekeeping practices contribute to high energy intensities.

The above mentioned problems also exist in many other developing countries in various degrees and forms. Each country has adopted policies and measures many similar to other countries and some peculiar to their own situations.

4. GOVERNMENT POLICIES IN INDIA

The policy instruments adopted so far by the Government of India to promote efficient use of energy in the industrial sector can be divided into two categories, viz., (1) Fiscal or economic measures, and (2) liberalization of import of certain energy-efficient equipment.

4.1 Fiscal Measures

In February 1982, the Government announced a 100 percent depreciation allowance, effective April 1983, on certain energy-saving devices and systems. These can be categorised in the following areas:

(a) Specialised boilers and furnaces

(b) Instrumentation and monitoring systems for monitoring energy flows

(c) Waste heat recovery equipment and cogeneration systems, and

(d) Power factor-correcting devices

Depreciation at 30 percent has also been allowed for renewable energy devices, which include:

(i) Solar energy devices
(ii) Wind mills and related equipment
(iii) Biogas plants and engines
(iv) Battery-powered or fuel cell-powered vehicles
(v) Agricultural and municipal waste conversion devices

(vi) Equipment for using ocean waves and thermal energy, and

(vii) Machinery and plants for the manufacture of any of the above items

4.2 Energy Equipment

Under the import-export policy of the Government, permission in the form of an import license is usually required for import of capital goods and equipment, spares, raw materials, finished goods etc. However, import of certain goods is allowed free of import license. These are items classified under OGL category. Since April 1983, import of the following energy conservation equipment, including systems and devices working on/used for renewable and alternate sources of energy, has been allowed by all persons under OGL.

(i) Wind driven generators

(ii) Solar energy equipment

(iii) Parabolic focussing systems of the automatic electronic tracking type, including photoelectric sensors

(iv) Portable exhaust gas and combustion analyzers

(v) Steam trap leak detector

(vi) Ultrasonic steam leak detector

(vii) Solar heat control film

Specified equipment in categories (i) and (ii) above are fully exempt from customs duty. Import of the other items is subject to payment of customs duties and levies at prevailing rates.

Other Measures

Apart from the above mentioned policies, the Government has proceeded along two other avenues.

Two governmental organisations - the National Productivity Council (NPC) and the Petroleum Conservation Research Association (PCRA) - offer a range of energy conservation services and assistance.

In addition, from time to time, the Government of India has constituted expert groups to examine specific aspects of energy supply and demand and recommend appropriate policy measures. The four groups appointed in recent times include (1) the Working Group on Energy Policy appointed by the Planning Commission, (2) the Committee on Power, (3) the Inter-Ministerial Working Group on Energy Conservation and (4) Advisory Board on Energy (ABE).

The ABE's activities have included formulation of a set of recommendations in various areas of energy conservation, which include power and the industrial sector.

The recommendations of these groups have been published, and some of these are discussed later.

5. GOVERNMENT POLICIES IN A FEW DEVELOPED AND DEVELOPING COUNTRIES

In the OECD (Organization for Economic Cooperation and Development) countries, large energy savings were effected not only through replacement of less efficient capital stock, but also through adoption of various housekeeping measures and small investments in energy-saving processes. In the developing Asian countries, it appears that relatively low cost energy-saving efforts have been neglected though these could potentially provide an important source of foreign exchange savings.

Economic pricing of energy gives major impetus to efficient use and encourages conservation measures. However, consumption of electricity and certain fuels continues to be subsidized. In addition, the government sector itself may be insensitive to prices, and special conservation measures may be required. Informational problems and capital market imperfections make it difficult for small enterprises to invest in energy saving measures.

The more important economic policies of a few foreign countries are briefly discussed below:

5.1 Developed Countries

a) Japan

Japan has been carrying out various measures for energy conservation since the oil crisis in 1973. Specifically, "the Law Pertaining to Rationalization in the Use of Energy" was promulgated in October 1979, and then thorough energy conservation measures were implemented under the Law. Japan provides a model of industrial energy efficiency, having made major gains since the early seventies. Briefly, Japan has concentrated on mandatory rationalization of energy use in industry, fiscal and economic incentives, R,D&D of energy conservation technology (Moonlight Project), assigning energy conservation events, and setting up of awards/commendations for groups and individuals, who have successfully endeavoured for the promotion of energy conservation.

(b) The United States of America

Industry in the U.S.A. is responsible for approximately 40 percent of the total amount of energy used in the country. It was estimated that a 20 percent increase in energy efficiency would save industry

approximately 20 billion dollars per year. Large industries have been spending money for energy conservation as the owner profits directly from energy conservation.

Legislation has been enacted in the U.S.A. to encourage cogeneration. The Public Utility Regulatory Policy Act, 1978 (PURPA) requires that utilities must buy power offered by cogenerator at its avoided cost at a negotiated rate.

The objectives of PURPA are

1. Conservation of electric energy
2. Efficient electric utility use of facilities and resources
3. Equitable rates to utility customers
4. Development of cogeneration and small power production

In the seven years since the enactment of PURPA, several hundred megawatts of electricity has been added to the grid. In California alone, almost 16,000 MW of capacity outside the utilities is being developed - a utility which would rank among the ten largest in the U.S.

The utilities have generally opposed PURPA on the grounds that the rate payers have to pay hundreds of millions of dollars since the cogenerator is paid at the avoided cost, and the system has some inherent reliability and operational problems. It is also contended by the utilities that there is little evidence of reduced reliance on oil and natural gas or increased efficiency in electric power production. It is generally believed by the utilities that the fourth goal above has been achieved at the cost of the other three goals. The implementation by Federal Energy Regulatory Commission and the States are blamed rather than PURPA and its intentions.

Certain tax benefits are available for industry. Energy measures usually qualify for a 10 percent tax credit and five year cost recovery. There are many other similar tax credits available to industry.

In the U.S. there is currently a lack of government policies in the area of conservation. Some measures that were initiated by the Carter administration, were subsequently changed or repealed by the Reagan administration. Many of the energy substitution programmes have been shelved, due to the current oil price situation. The current emphasis is on the principle of the market forces deciding as to what the industry does to conserve energy. The industry has taken steps voluntarily to reduce energy consumption, as it makes good sense in a competitive environmemt.

It is interesting to note that the Office of Technology Assessment in the United States has stated in one of its recent reports that for many years to come, energy need not be a constraint to economic growth in the U.S.A. OTA projects that in the next two decades investments in new processes, changes in product mix, and technological innovation can lead to improved industrial productivity and energy efficiency. As a result, the rate of industrial

production can grow three times faster than the rate of energy use needed for that production.

(c) Canada

In Canada, a unique method of implementing energy conservation in industry was devised by the industry leaders - it is a voluntary programme. The plan, with some over-simplification, was as follows:

1. Industry would commit to a voluntary programme to encourage industrial energy conservation.

2. This programme would include, as far as practicable, all industries across Canada.

3. Voluntary targets for improving the efficiency of energy use would be established by industry, and a regular schedule of reporting progress toward these goals would be maintained.

4. Efforts would be made to share non-proprietary energy conservation technologies between companies.

5. Primarily through its employee work force, industry would seek to promote energy conservation in the off-the-job environment of the larger social community.

As a first step, ten Industry Sector Task Forces were established to promote the objectives of the voluntary programme. Goals for the year-end 1980 were set for each type of industry. Through various measures, including energy audits, reporting and implementation, it has been reported that the Canadian industry on average has exceeded its 1980 target a year ahead of schedule. In the process, an energy demand equivalent of 43 million barrels of crude oil per year is being avoided.

The federal government provides assistance and support to the voluntary programme. While the government does not direct and administer the effort, a close coöperative liaison is maintained to assure that industry is kept aware of government's priorities and proposals. Government, in turn, is kept informed of industry's problems, opportunities and limitations. The relationship has, to date, been candid, cooperative and highly productive.

In addition to an observer status in the Task Force system, the Government plays a role in providing incentive and development programmes to further encourage industrial conservation. Over 100 million dollars per year of federal funds are currently allocated for such programmes. In many cases, federal funds are supplemented by the provinces.

Tax write-off on conservation investments is provided by allowing a 2-year straight line depreciation on certified capital investments. Heat recovery, cogeneration, low-head hydroelectric power, solar and biomass investments are included.

Is the voluntary system working ? To the satisfaction and pride of both government and industry, the expectations are being exceeded in the number of participants and in the amount of energy being used and saved.

5.2 DEVELOPING COUNTRIES

(a) Philippines

The Philippines like any other developing nation is faced with problems of increasing population and the need to raise the GNP. Therefore, the government is concerned about the efficient use of energy, especially during periods of increased economic activity. The energy programme in the Philippines is based on the following objectives:

1. Supply Objective: To provide timely, adequate, secure and affordable energy supplies to support the development plans of the government.

2. Efficiency Objective: To promote the best use of fuels, within the context of the existing institutions and constraints.

3. Environmental Objective: To ensure that both the objectives above are met in an environmentally acceptable fashion.

The following policies related to energy management in industry as well as other sectors influenced the energy consumption directly:

1. The use of fiscal measures for reflecting the real economic and social costs of energy.

2. Government's rationing of supply in times of emergency.

3. Direct government intervention to accelerate development of market for non-oil fuels in support of the oil substitution program.

4. Promotion of energy conservation via the media, conservation authorities and energy users.

To implement the above policies, two organisations were created under the Ministry of Energy. The Bureau of Energy Development was responsible for development of energy resources, and the Bureau of Energy Utilization (BEU) took care of regulating energy-related business, monitoring the energy supply and demand, and formulating the energy conservation programme.

The BEU's function relating to energy conservation include the following:

1. Formulate, develop and periodically review as necessary a comprehensive national energy conservation programme.

2. Conduct energy audits to evaluate and help improve energy efficiency.

3. Develop and adopt norms for energy consumption.

4. Mandate energy intensive industrial units to submit energy impact assessments.

The energy conservation program has four principal components: energy utilization management, training programmes, promotion and information dissemination. Managing energy use involves information collection, monitoring and audits. The training programmes are directed towards managers, professionals and technical staff to develop their awareness and interest in proper management of energy use in industrial and commercial firms. Conservation techniques are disseminated in workshops and seminars.

It has been reported that through energy conservation measures, the Philippines has achieved the following percentage savings in some of the energy-intensive industries: Cement - 17.2 %; Fertiliser - 40.4 %; Pulp and Paper - 40 %; Steel/Metal - 34.9 %; Chemicals - 18.1 %.

In general, the Phillipines has made considerable efforts in industrial energy conservation and has achieved good results. This has mainly been possible through an integrated approach between the government, public and private organisations, and industry.

(b) Indonesia

Indonesia currently meets 80 % of its commercial energy requirements from indigenous oil. The country also has abundant reserves of gas and coal as well as geothermal and hydro-electric potential, which is largely underdeveloped.

It is now estimated that 43 percent of the commercial energy consumed in the country is in the industrial sector. Being the largest consumer of energy, there is a great potential for conservation measures in the industrial sector.

Being a petroleum exporter, Indonesia gets most of her foreign exchange to finance the national development from oil exports. It still hopes to be able to increase its oil exports, and at the same time meet the domestic demand.

The Indonesian government has adopted a General Policy on energy, to substitute oil energy sources with non-oil ones wherever possible, and to conserve oil as much as possible to maintain oil exports.

To achieve the above mentioned objectives, the government has pursued the following four basic avenues:

1. Intensification of the survey and the exploration of all energy resources in Indonesia to know the real energy resource reserve and potential.

2. Diversification of the energy source and use, so that the oil share to meet the energy demand decreases.

3. Conservation of energy to rationalize the energy use for all purposes without harming development.

4. Identification of the most suitable energy for specific purposes.

The energy conservation policy is being implemented through the following programmes:

1. Public campaign and the dissemination of technical information, starting from the government offices and state-owned industries.

2. Technical guidance to intensive energy consuming entities, especially the larger ones which are supported by sufficient number of technically capable managers and employees, and funds.

3. Issuance of regulations as a presidential promulgation.

So far the energy policies and measures adopted by Indonesia have been of very limited nature. As in the case of most developing countries, there is a vast potential for energy conservation, and hence formulation and implementation of appropriate government policies.

6. POLICY RECOMMENDATIONS FOR INDIA

In the work of the earlier government-appointed committees in India, there was greater emphasis, understandably, on aspects of energy supply. More recently-constituted expert groups have focussed considerable attention on energy consumption and conservation aspects with growing recognition of their importance, and of conservation as an alternate source of energy.

Some of the important recommendations of the expert groups and other experts in this field are given below. (Reference to expert groups is shown against the respective recommendations, and the names of these groups are given in footnotes.) Suggestions as to the name(s) of the group(s), which could be entrusted with the implementation of these recommendations are given within brackets.

a. Technical and Operational Measures

- Detailed energy audits should be carried out in at least all large and medium-sized industries[1/] (Industry Associations, Engineering Organisations through Energy Audit Service Organisations like NPC).

1/ Advisory Board on Energy.

- Measures to improve the efficiency of energy utilisation in industries should be the most important element of energy policies in the industrial sector. Standards for fuel efficiency for each type of industry should be fixed with gradual improvement in efficiency over time, and their achievement monitored[2/] (ISI, ABE).

- Special attention should be paid to savings in the use of oil. Substitution of oil with other types of fuel including coal should be actively pursued[2/] (PCRA, NPC).

- Cogeneration possibilities in existing industries should be identified and pursued, if necessary by providing financial incentives[2/] (SEBs, CEA, Department of Power, Financial Institutions)

b. Fiscal and Economic Measures

- Investments and subsidies for energy conservation schemes should be created, to be expanded to around Rs. 100 crores every year, over a span of 10 years, by levying an energy conservation cess on industrial consumption of petroleum products, coal and electricity[3/] (Ministry of Energy, Ministry of Finance, Financial Institutions).

- customs duty relief on both components and equipment should be offered[3/] (Ministry of Finance).

c. Energy Pricing

- Energy pricing policies must ensure that (i) sufficient surplus is generated to finance energy-sector investments, (ii) economies in energy use are induced, and (iii) desirable inter-fuel substitution is encouraged[2/] (Planning Commission, BICP).

- Energy prices should be raised so that they at least reflect long-run marginal costs and allow for a reasonable return. A further increase in the form of a conservation cess may be desirable to promote conservation of resources and economy in general use[2/] (BICP, Ministry of Energy).

- The energy pricing system should be structured so that the price to the user reflects the real costs of supplying energy[2/] (BICP).

- Penal levies on industries, which exceed laid down norms of consumption, and fiscal incentives for those who improve on them should be considered[4/] (ABE, Ministry of Energy).

2/ Working Group on Energy Policy

3/ Inter-Ministerial Working Group

4/ Committee on power

d. Industrial Licensing, Production and Growth

- Before new units are licensed, the capacities of the existing units and the capacity utilisation factors for these units should be taken into consideration (DGTD).

- In setting up new industries, the technologies used should be the least energy-intensive options, particularly with respect to the use of depletable sources of energy and electricity[2/] (DGTD).

- The possibility of utilising waste heat from power plants, especially the large super thermal stations, by setting up appropriate industries in the vicinity should be seriously considered[2/] (Ministry of Industry).

e. Organisational Measures

- In large and medium-sized industries, it must be made mandatory to appoint energy managers, who are suitably trained. in small-scale industries, a mechanism of energy auditing, reporting and improvement in energy use should be instituted (Company Law Board, Ministry of Industry, Industry Associations).

f. Energy Equipment

- Better standards for various energy using equipment must be set (ISI)).

- Restrictions must be placed on the production and sale of low-efficient motors and transformers[4/] (DGTD, DGSD, Ministry of Industry, ISI).

- Manufacture of sophisticated instruments required for monitoring energy flows must be encouraged. Import of such instruments and spare parts should be free of customs duty (Ministry of Industry, DGTD, Ministry of Finance).

g. Research and Development

- Each major industrial process should be reviewed to identify the R&D efforts required to reduce energy consumption[2/] (Department of Science and Technology).

- R&D programmes in energy conservation technologies should be sponsored by the government as a distinct component of the Science and Technology plan[3/] (Department of Science and Technology).

2/ Working Group on Energy Policy
3/ Inter-Ministerial Working Group
4/ Committee on Power

h. Other Measures

- Formal training courses for developing energy conservation expertise should be introduced in various technical institutions to maintain a steady flow of experts in the field (Department of Science and Technology.)

- A system of governmental recognition and awards should be instituted for honouring individuals and organisations for outstanding performance in energy conservation[3] (NPC).

- To create energy conservation awareness, pamphlets in local languages, suitable documentary films and programmes on radio and television should be introduced[3] (Ministry of Information and Broadcasting, NPC).

7. CONCLUSIONS

The preceding sections demonstrate that in the field of energy conservation different countries face different problems. They have different financial, technical and physical resources to cope with the problem of rising energy costs and measures to reduce them.

It is evident that changes in energy use will occur voluntarily where the economic choices are clear. But the adjustments that need to be made will vary according to the existing structures and the resources endowments of individual economies.

In the developing countries, more stringent policies and measures are required to improve energy intensities, and overall energy consumption. It is high time that the governments act, before it is too late to control the escalating energy use and wastage. A carat-and-stick policy may be in order.

The tasks outlined by various expert groups in India are so complex and formidable in nature, that they require a strong institutional infrastructure and integrated approach for implementation of energy conservation across the board. The experience of other countries points in the same direction and shows that the ideals of conservation can be translated into reality only if they are backed by appropriate administrative, legal and financial inputs. In this regard, it is important for the government to assess as to how best the existing government departments and institutions can be used/restructured to face the challenge.

Although promotion of energy conservation policy has an effect of decreasing bad influence on the environment, promotion of environment policy may lead to energy increase. Therefore, it is important that necessary coordination between the two be maintained in the course of promotion of these policies.

3/ Inter-Ministerial Working Group

ENERGY EFFICIENCY IN ELECTRIC LIGHTING

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ABSTRACT

This paper summarises findings from a study conducted by Tata Energy Research Institute on the impact of energy-efficient lighting technologies on the peak load demand in India. A detailed representative survey of domestic and commercial electricity consumers in South Bombay has been used as a basis for estimating the contribution of lighting load to the peak load for India. Impact of substituting inefficient electric lighting devices with efficient ones on an all-India basis has been quantified in terms of costs and benefits. Using indigenous high efficiency lighting technologies in place of inefficient ones, every crore of rupees invested in lighting technology replacement releases 1.71 MW of installed capacity at peak load time. Using internationally proven energy-efficient technologies for replacing inefficient lighting technologies, every one crore of rupees invested in lighting technology replacement releases 2.11 MW of installed capacity at peak load time. In addition to releasing installed capacity at peak load time, the technology replacement will also yield attractive returns in terms of cost of electricity saved. The annual savings resulting from decreased use of electricity approximately equal 15-18% of the investment.

BACKGROUND

Human vision is not equally sensitive to light of all colours. Short and long wave length light (ultra-violet and infra-red) is completely invisible to us. Sensitivity of our vision gradually increases as the wave length increases starting from deep violet towards blue-green (wave length at maximum sensitivity = 5555 x 10^{-8} cm). Senstivity of our vision decreases from blue-green as the wave length increases further; human vision is not sensitive to wave lengths beyond Infra-red.

Electric lighting devices convert electrical energy into light at different wave lengths. The useful quantity of light, so far as human vision is concerned, thus depends on both the efficiency of conversion from electrical energy to light energy at different wave lengths, and the sensitivity of human vision to those particular wave lengths. Integrating these two parameters, a common single number is obtained (called Luminous Efficacy with units of lumens/Watt) denoting the effectiveness with which a lighting device converts energy into visible light. Luminous efficacies of electric lighting devices range from 10 lumens/Watt to 110 lumens/Watt.

It is generally known that the occurrence of peak load in Indian power systems almost always falls between 5 pm and 9 pm, coincident with the use of electric lighting by domestic and commercial consumers. Since

the addition of new capacity has always fallen short of targetted additions over the different Five Year Plans, various demand management strategies must be investigated thoroughly. Moreover, one must identify the best strategy for new investments in the complex formed by generation, T&D, and end-use at peak load time.

SUMMARY OF RESULTS

A project was undertaken by TERI to determine the impact of energy-efficient lighting technologies on the peak load for India. The project has been funded jointly by TERI and the Advisory Board on Energy. Results from three years of research are summarized below.

The study was based on detailed investigation of electricity used for lighting by domestic and commercial consumers in South Bombay's Carnac region. The duty cycle figures in the Carnac sample of incandescent and fluorescent lamp, wattage shown in Figs. 1 and 2, have been used together with the estimates of installed wattage of lamps in the country to arrive at the estimated lighting load for the country as a whole as a function of time. In these calculations the assumption has been made that all fluorescent lamps are rated at 40W and the average of the incandescent lamps in the country are also rated at 40W. The lighting load in the country calculated under these assumptions is referred

to as the "base" case. The lighting load as a function of time is shown in Fig. 3 with sensitivity curves which are detailed in the final project report.

According to estimates the lighting load peaks between 5.30 pm to 10 pm with the maximum value of approximately 7810 MW at 7 pm. In terms of the existing lighting technologies available in India, the only high efficacy replacement for incandescent lamps (in the range of 25 W to 150 W) are the standard 20W or 40 W fluorescent lamps. A 20 W fluorescent lamp gives same amount of light as a 100W incandescent lamp. If all the incandescent lamps (assumed average wattage 40 W) used in the country were to be replaced with 20W fluorescent lamps, the resulting lighting load as a function of time is shown in Fig. 4 together with the base estimate. Of course it is not cost-effective to replace incandescent lamps with low duty cycles (lamps in bathrooms, toilets, in residential staircase, etc.) with fluorescent lamps. However, for the sake of a conservative analysis this distinction has not been made. The savings in peak load resulting from this replacement* (termed as maximum potential savings with technology available in India) will equal 1654 MW at the end-use point, which would equal 1985 MW at the generation point. This is equalent to 3969 MW in terms of installed capacity.

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* Calculations were made using 25 W, since 20 W lamps consume 25 W (inclusive of power consumed in choke).

Incandescent lamps upto 100W can be best replaced with fluorescent lamps in the wattage range 8 W to 12 W. Such compact small fluorescent lamps are already commerically available and in use in the United States, Western Europe, Japan and several South-East Asian countries. This lighting technology can be considered as proven. If these lamps are produced in India and are used in place of incandescent lamps, the maximum potential savings can be estimated in the same manner as described above. The contribution to electric load from lighting resulting from such a replacement on an all India basis is shown in Fig. 5. The savings in evening peak load is estimated at 3307 MW at the end-use point; this translates to 3969 MW at generation point; and equals 7938 MW in terms of installed capacity.

The above estimates are conservative, since at every point of uncertainty in the preceding analysis, the attempt has been to use conservative estimate amongst the available options. It is very likely that the real value of maximum potential savings (in terms of peak demand or installed capacity) is larger than the conservative estimates given here.

The contribution of lighting at peak time (7 pm) has been estimated at 7810 MW. This is comprised of 4411 MW from incandescent lamps and 3399 MW from fluorescent lamps. The base proposal in terms of existing indigenous technology is to replace all

incandescent lamps with 20 W fluorescent lamps*. Assuming a rate of investment in generation and T&D of Rs. 1.2 crores/MW of installed capacity, the savings to the economy in terms of reduced investments in the power sector to meet the peak demand will be Rs. 4763 crores. The cost of substituting the incandescent lamps by fluorescent lamps is estimated at Rs. 2320 crores. This is based on a retail price of Rs. 80/unit for the best quality 20 W fluorescent lamp, including the cost choke and fixtures.

Seen alternatively, for every crore of rupees invested in replacing existing incandescent lamps with 20 W fluorescent lamps, 1.71 MW of installed capacity is released at peak load time to the system.

In addition to doubling available illumination, and saving Rs. 2443 crores (Rs. 4763 crores saved in power generation and T&D by investing Rs. 2320 crores in fluorescent lamps and fixtures), this proposal will also save 3.92×10^9 units of electrical energy consumption per year, worth Rs. 447 crores annually (at the marginal cost of Rs. 1.14/unit consumed).

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* A 20 W fluorescent lamp has a luminous efficacy of 55 lumens/Watt and this will produce 1100 lumen. This light output is only slightly less than the illumination obtained from a 100 W incandescent lamp. Since most of the incandescent lamps in the country are rated at 40-60 W, this proposal will approximately double the illumination available to the user of replaced lamps, in addition to savings to the economy.

A logical approach to subtituting fluorescent lamps in place of incandescent lamps would be to maintain the number of lumens presently available to the users of incandescent lamps. This can be achieved by installing low power fluorescent lamps currently available in the international market in place of incandescent lamps. These fluorescent lamps are rated at about 8 W and consume about 10 W of power after taking into account power lost in their choke. The lamps retail at the present for about US $ 10 (Rs. 130/-) per piece. Assuming that 8 W lamps are used (with a 2 W loss in the choke) in place of incandescent lamps, this replacement would result in savings of 3307 MW at the point of end-use; this translates to 3969 MW of generation which equals 7938 MW of installed capacity released at peak time. The cost of replacing 290 million incandescent lamps with these low power fluorescent lamps works out to Rs. 3770 crores. Thus for every crore of rupees invested in replacing incandescent lamps with state-of-the art compact fluorescent lamps, 2.11 MW of installed capacity will be released to the system at peak load time.

If fully implemented, this option will save the economy Rs. 9526 crores of investment in generation and T&D for an investment of Rs. 3770 crores in low power (10W) fluorescent lamps. The annual savings in electrical energy consumption will be 7.83×10^9 units

which translates into savings of Rs. 893 crores annually (at rates mentioned earlier). The all India electric lighting load for these two options is compared with the existing lighting load in Fig.s 6.2 and 6.3.

POLICY OPTIONS

The various alternatives for achieving the potential load savings at peak time resulting from the use of energy efficient lighting can be broadly categorised in five areas :

(A) Legislation

(B) Financial (Credit) Policy

(C) Tax Structure

(D) Education

(E) Organisational Support

These are spelled out in more detail below.

A. Legislation

1. To improve the energy efficiency of lighting in the new stock of buildings (i.e. buildings which will be designed and constructed in the future) it may be desirable to require installation of atleast one fluorescent light in every room of the new building as a requirement for obtaining the building completion certificate. It is expected that with the installation of the fluorescent lamps, the tendency to use these by the occupants

wouuld increase. Indonesia, for example, has a similar but weaker legislation that requires installation of one fluorescent lamp in every apartment/residential unit for obtaining compliance with the building regulations.

2. The Indian Government at the central, state and municipal levels is the single largest employer in the country. A good percentage of the government employees either live in government quarters or qualify for government housing loans. Government quarters as well as those built by government employees using government funds can be required to install fluorescent lighting.

3. Financial institutions such as LIC, HDFC, etc. provide loans to various individuals for constructing residential units. Since the financial institutions are under government control, it is possible that installation of fluorescent lighting can be a requirement for compliance with the loan formalities.

4. For improving the efficacy of lighting in the existing stock of buildings a different approach would have to be followed. All existing residential and commercial units pay a building tax to their respective municipalities. A rebate on the tax payable to the municipality may be announced for those units which have fluorescent lighting installed in each room. To ease the problems arising from shortage of fluorescent lamps if such a policy were to be effected suddenly, the announcement of

the policy can be made several months before its date of implementation. The Central government may compensate the municipality for any resulting loss of revenue.

5. Licensing procedure for production of lamps of high luminous efficacy (say above 40 lumens/watt) can be liberalised or deregulated altogether. Production of chokes, fixtures, etc. of high energy efficiency can also be liberalised or deregulated. At present, licensing for any additional capacity for production of chokes has been restricted to the small sector.

B. **Financial (credit) Policy**

1. For large consumers it may be possible to establish a circulating fund for upgrading of incandescent lamp points to "fluorescent lamp points" (this includes choke, starter and the patti). Since the switch over from incandescent to fluorescent lamp points can take place in a phased manner, such circulating funds can be quite small and can be locally managed for better effectiveness.

2. Local utilities and State Electricity Boards can provide fluorescent lamp points to end-users on a hire and purchase basis. This system has an additional advantage in implementation since the lease payments can be automatically added to the electricity bill of the customer. Experience in the developed countries has shown that

electricity conservation programmes managed by the utilities have been very successful whenever a small staff has been set up within the utility with responsibility exclusively for electricity conservation measures. In those cases where the responsibility was added on to existing responsibilities of some utility staff, the conservation programmes have generally tended to fail.

C. Tax Structure

1. The Central Government directly regulates the rate of excise duty charged on various commercial items. It is recommended that the excise duty structure on lamps should be designed in slabs of luminous efficacy of the lighting devices. Presently this practice is not followed and the excise duty structure does not favour high luminous efficacy lamps. At the state level (and at the central level in Union Territories) a similar tax structure can be followed.

2. Presently, import of capital equipment for production of lamps of high luminous efficacy attracts heavy customs duty. This can be reduced considerably since the benefits to the Indian economy from large scale use of high efficacy lamps will greatly outweigh any loss of revenue resulting from reduced customs duty on capital equipment for their production.

D. Education

1. It is important to organise consumer education campaigns to remove misconceptions, prejudices and reluctance to use fluorescent lamps in place of incandescent lamps, particularly at the domestic level.
2. Training programmes for policy makers at the municipal, state and central government levels have to be organised for effectively implementing the measures outlined earlier in this section.
3. Enthusiatic support from utilities and State Electricity Boards will be required as they are to operate hire purchase schemes for fluorescent lamp points for their customers. Training programmes for organizing hire-purchase schemes need to be held for officers from utilities and SEB's.
4. Producers of lamps should be encouraged to keep their technology up-to-date. They should also be encouraged to offer a variety of high-efficacy low-wattage lamps to domestic and commercial consumers so that there is improved acceptance of these lamps in the market. In this context it is important to note that no Indian manufacturer markets fluorescent lamps of "warm white" colour, which seems to be more acceptable to domestic consumers in developed countries than "cool daylight" colour presently produced in this country.

E. **Organisational Support**

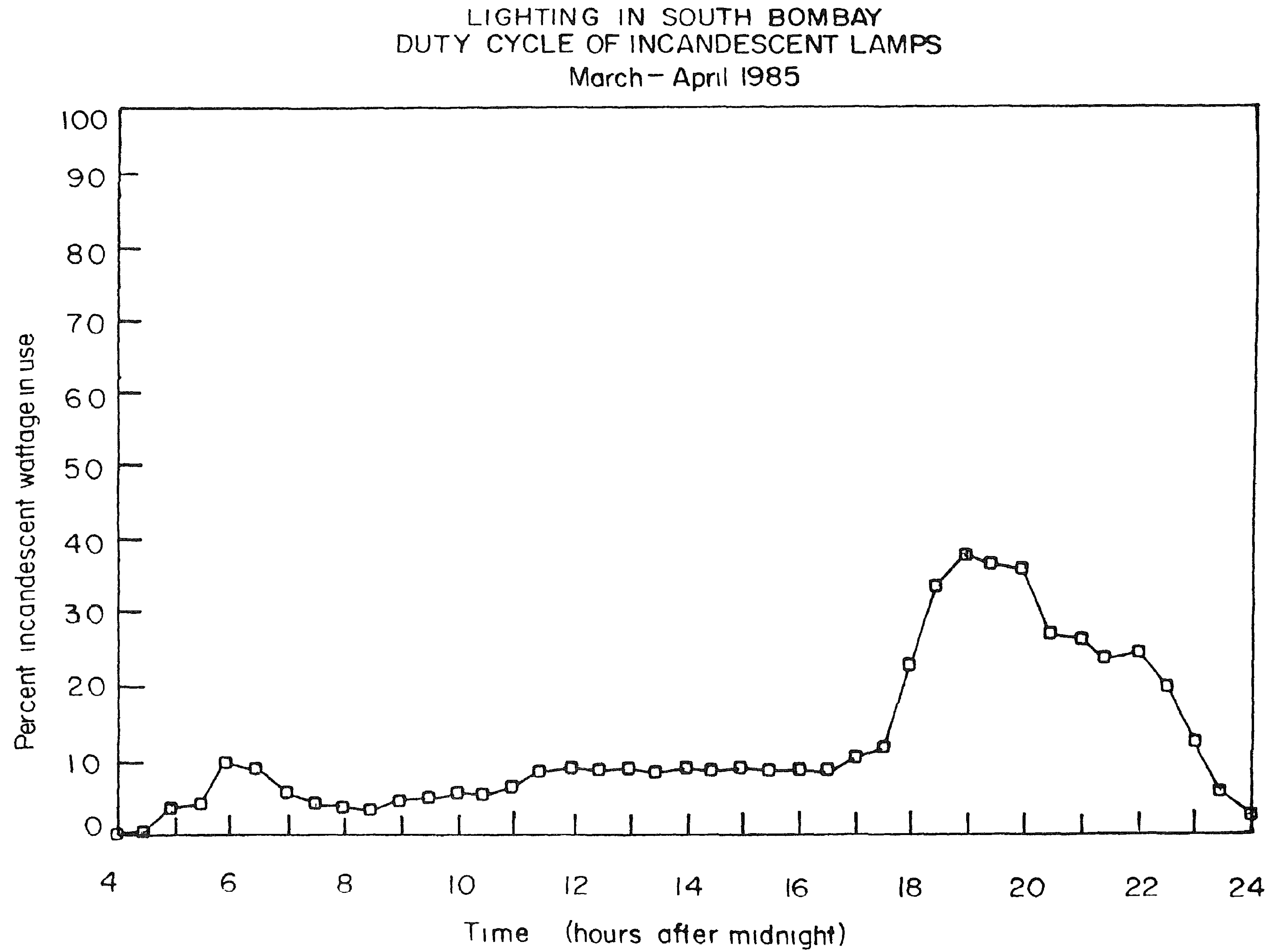
1. The Indian Standards Institution should establish facilities for testing luminous efficacies of a variety of lamps. The existing facilities should be considerably strengthened and expanded so that ISI certification can be obtained rapidly. ISI should also award luminous efficacy grade to lamps so that the excise and tax structure can be linked to these grades. Energy efficiency of chokes should become a subject of ISI regulation since poor quality chokes can waste as much as 25% of the energy consumed in the fluorescent lighting system.

2. Organisational systems for operating hire purchase arrangements of fluorescent lamp points should be established in local utilities and State Electricity Boards. These schemes should be first implemented in those areas where the supply voltage is adequately high for using fluorescent lamps.

3. In those areas where the supply voltage is not adequate, investments have to be made in upgrading transmission and distribution facilities to bring the supply voltage to the level required for operating fluorescent lamps.

4. In those localities where the SEBs and local utilities encourage a large scale switch over to fluorescent lamps, capacitors for power factor correction should be integrated with local T&D network.

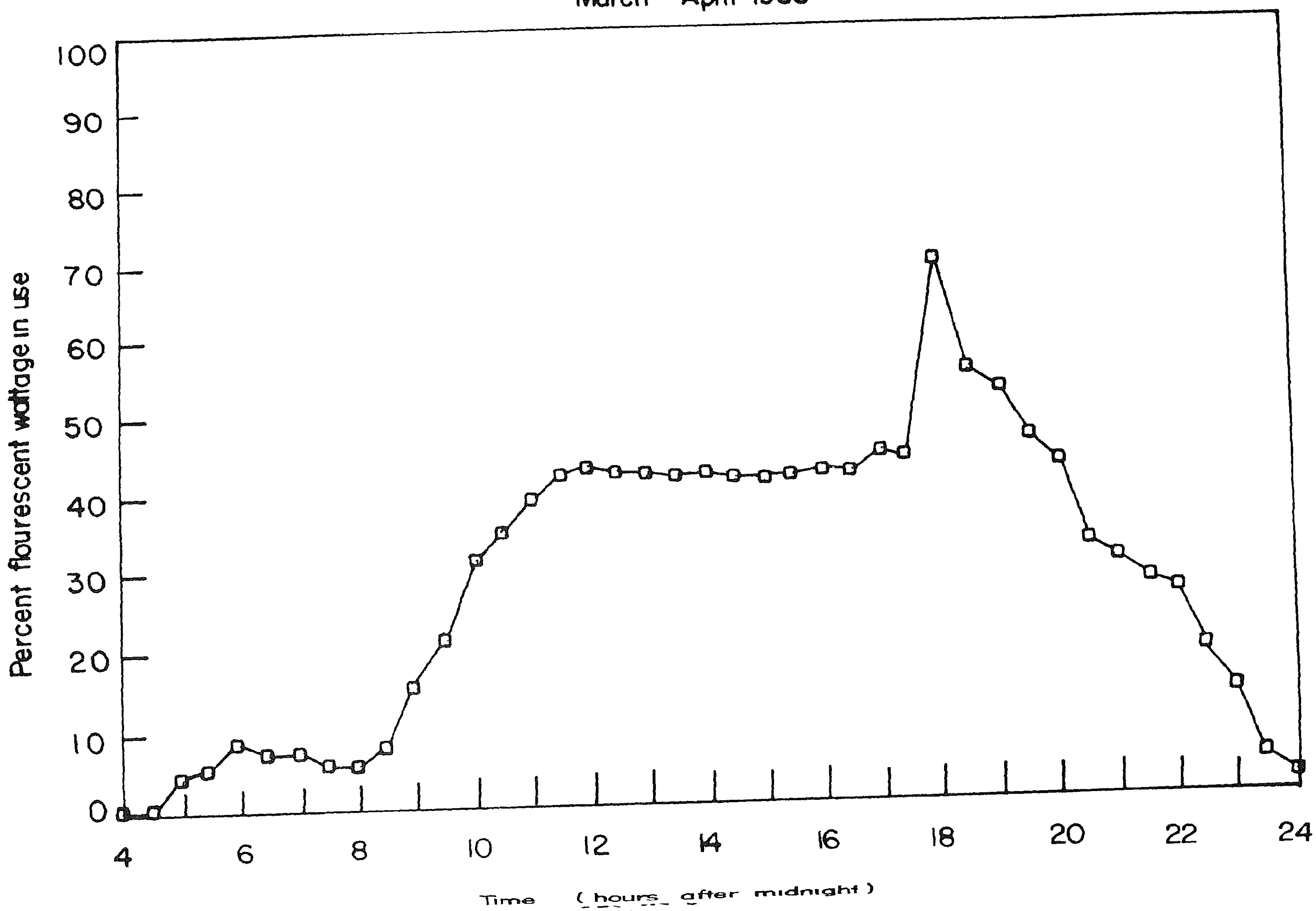
5. An office for demand management (with no other additional responsibilities) should be created in every utility. This office should have the responsibility of implementing energy-efficient technologies, and studying and recommending various policy and tariff options for the utility customers to reduce the peak load demand.



LIGHTING IN SOUTH BOMBAY
DUTY CYCLE OF INCANDESCENT LAMPS
March - April 1985
Percent incandescent wattage in use
100
90
80
70
60
50
40
30
20
10
0
4
6
8
10
12
14
16
18
20
22
24
Time (hours after midnight)

FIGURE 2

LIGHTING IN SOUTH BOMBAY
DUTY CYCLE OF FLOURESCENT LAMPS
March – April 1985



ALL INDIA LIGHTING LOAD CURVE

March-April 1985

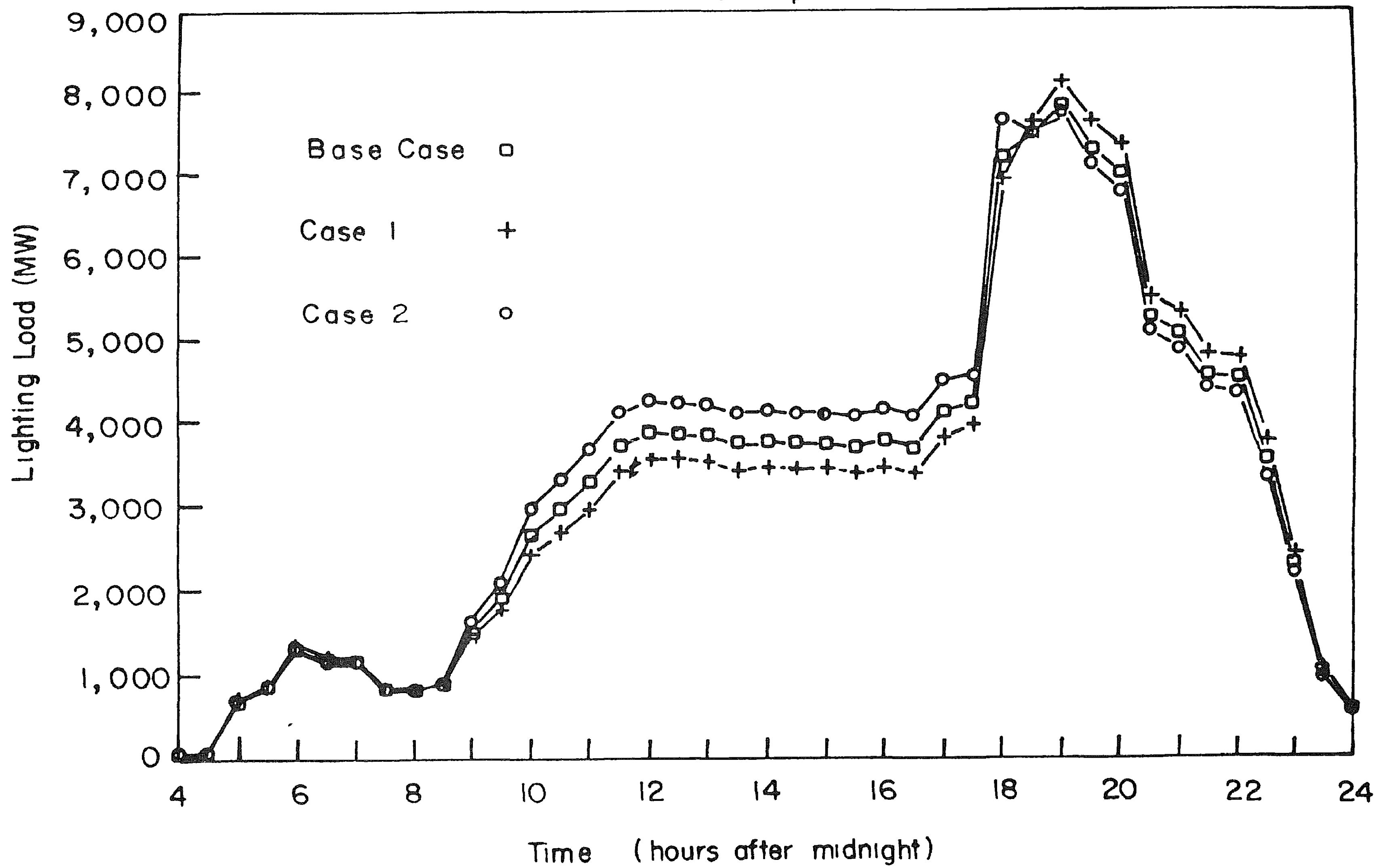
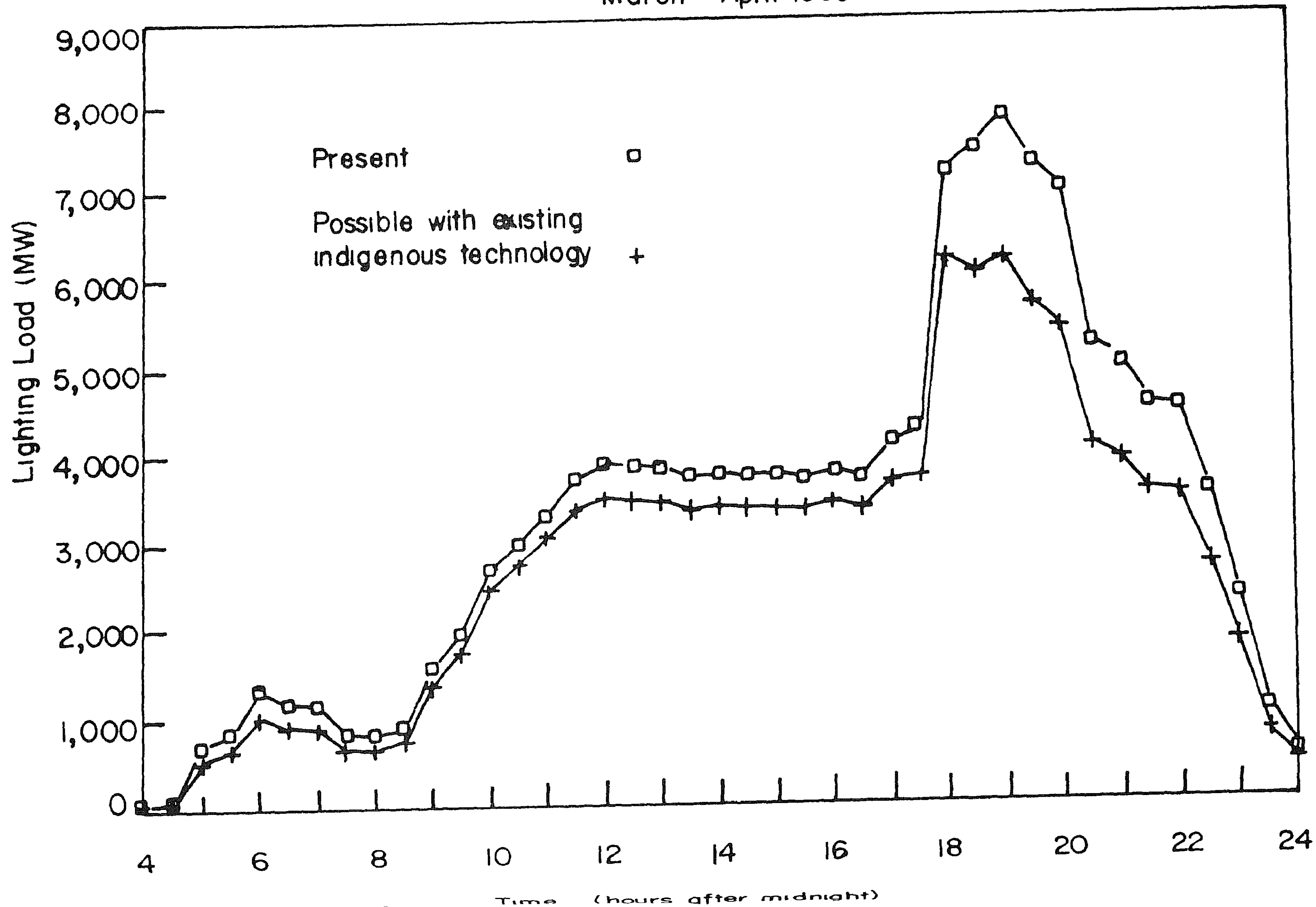
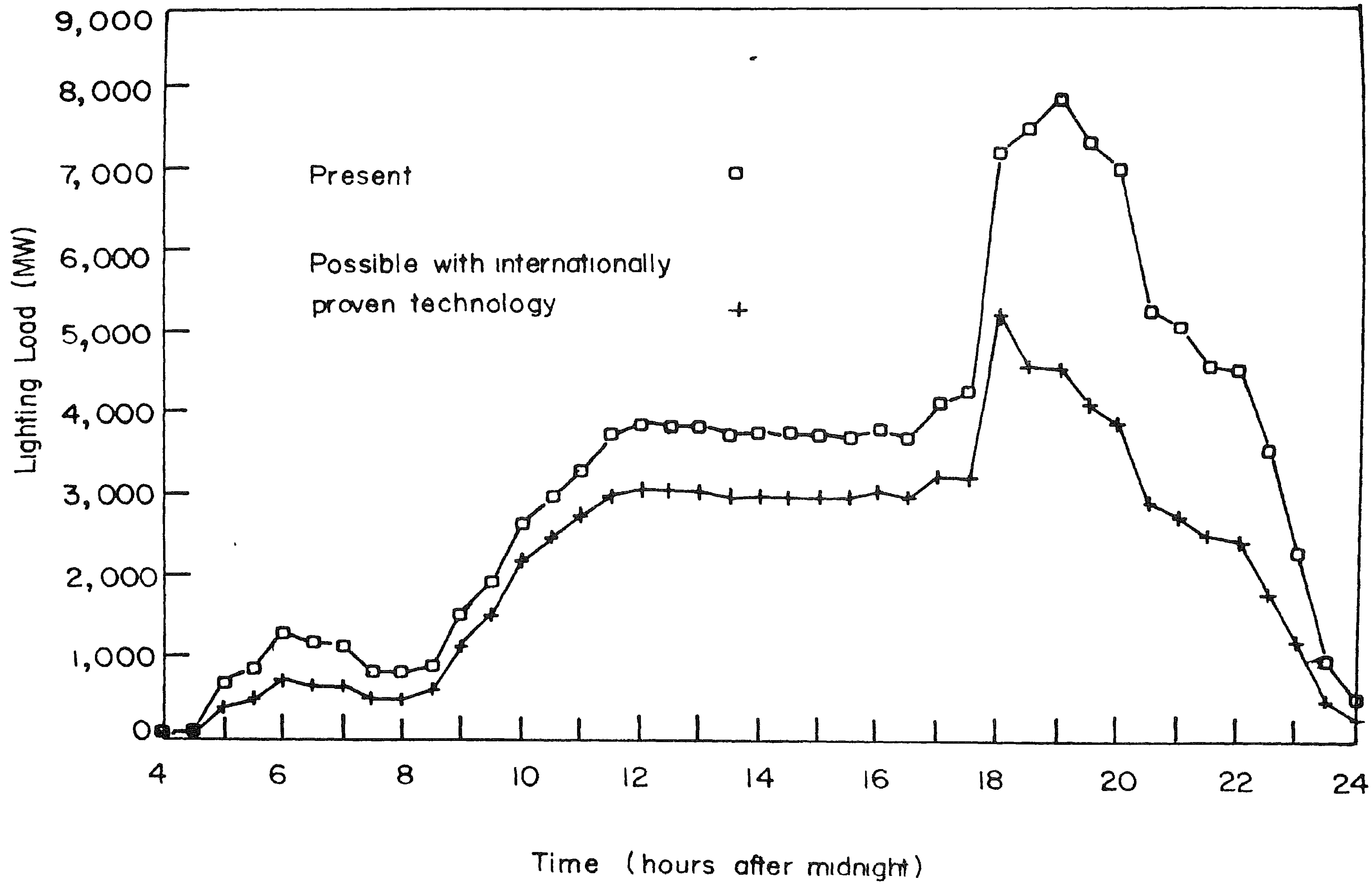


FIGURE 4

ALL INDIA LIGHTING LOAD CURVE
MAXIMUM POTENTIAL SAVINGS WITH EXISTING INDIAN TECHNOLOGY
March – April 1985



ALL INDIA LIGHTING LOAD CURVE
MAXIMUM POTENTIAL SAVINGS WITH PROVEN INTERNATIONAL TECHNOLOGY
March – April 1985



Strategies For Improving Efficiency Of Electric Motors In Industry and Agriculture

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of generation capacity (assuming 20 % losses in transmission and distribution and a plant load factor of 4000 hours/year) to be made available to meet the nation's growing electricity demands.

Population Characteristics of Electric Motors

Electric motors transform electrical energy into mechanical energy in the form of rotating shaft power. They are used in an enormous variety of applications such as pumps, compressors, fans, blowers, conveyors, cranes, hoists, crushers, pulverisers, agitators, machine tools, process machinery, traction drives etc., and find widespread use in all industries as well as in other sectors of the economy. In the agricultural sector, electric motors are used mainly for pumping of water for irrigation.

Broadly, electric motors can be classified as AC (alternating current) motors or DC (direct current) motors. AC motors can be further classified as synchronous or induction motors. Sizes of electric motors vary from very small fractional horsepower motors to very large motors rated at a few thousand horsepower. In the integral horsepower (> 1 hp) sizes, AC three-phase squirrel cage induction motors comprise the overwhelming majority of the industrial sector electric motor population. Agricultural sector motors are generally in the 2-10 hp range.

The total annual production of electric motors excluding alternators in India is about 2.6 million kW in terms of rated mechanical output. Of this, squirrel cage induction motors account for an estimated 2.15 million kW. Apart from data on total annual production, very little information is available about the pattern of motor production/sales classified with respect to factors of interest such as type, size (rating), end-user (i.e. type of industry), end-use (i.e. type of application) etc. In the absence of such data for India, Table 1 presents data for the U.S. on the estimated population distribution and electricity consumption in electric motors in the industrial sector as well as in all sectors (excluding motors in transportation equipment).

Introduction

The industrial sector is the largest consumer of electricity in India. In 1982-83, electricity sales by utilities to industrial units amounted to 52,967 GWh or over 55 % of total electricity sales. Additionally, 8,744 GWh of self-generated electricity was also consumed. Thus, the total consumption of electricity in the industrial sector was 61,711 GWh, which was a little under 60 % of the nation's total electricity use in 1982-83. The agricultural sector is the next largest consumer; 1982-83 electricity consumption was 17,817 GWh or almost 19 % of utility sales.

Although no reliable estimates exist or have yet been attempted, it is generally estimated that about 60-70 % of the electricity consumed in industry and 80-85 % in agriculture is in electric motors. In 1982-83, consumption in electric motors in industry and agriculture would therefore be of the order of 40,000 GWh and 15,000 GWh respectively. When electric motors in the domestic, commercial and transportation sectors of the economy are also considered, the total consumption would undoubtedly be far greater.

While electric motors consume large amounts of energy, most of this energy is, in fact, converted to useful work. The energy actually 'consumed' by an electric motor is the energy dissipated as electrical and mechanical energy losses within the motor; the balance is usefully transferred as mechanical energy to the driven device. Nevertheless, there still is considerable scope and potential for energy savings with significant financial benefits. If one assumes that the average electric motor efficiency is currently 75 %, then an increase in average efficiency to 80 % would result in annual savings of approximately 2,500 GWh in the industrial sector alone. This translates to savings to industry of Rs. 150 crores annually at an electricity cost of Rs. 0.60/kWh. For the agricultural sector, a similar calculation shows possible saving of 1,000 GWh. Viewed another way, these savings of 3,500 GWh would enable about 1,100 MW

Table 1

Estimated U.S. Electric Motor Population and Electricity Consumption, 1977

Size Range	Industrial Sector 1/				Total U.S. 2/			
	Population		Consumption		Population		Consumption	
hp	'000 units	% of total	GWh	% of total	'000 units	% of total	GWh	% of total
< 1	4,475	28.5	383	0.1	658,378	90.3	30,493	2.5
1.0 - 5	4,130	26.3	3,793	0.7	54,583	7.5	33,942	2.7
5.1 - 20	4,390	28.0	45,892	7.7	10,421	1.4	103,449	8.4
21 - 50	1,470	9.4	90,094	15.2	3,313	0.5	155,177	12.6
51 - 125	785	5.0	177,614	29.9	1,703	0.2	337,739	27.4
> 126	434	2.8	275,527	46.4	1,004	0.1	573,277	46.4
Total	15,684	100.0	593,303	100.0	729,402	100.0	1,234,077	100.0

1/ Includes mining and manufacturing sectors

2/ Excludes transportation equipment

Source: U.S. Department of Energy, Classification and Evaluation of Electric Motors and Pumps, DOE/CS-0147, Washington D.C., February 1980.

Two interesting points emerge from the above data with respect to motors in the industrial sector. The first is that the bulk of the motor population (> 80 %) is comprised of motors having sizes less than 20 hp (15 kW). The second is that although motors of size greater than 126 hp (94.5 kW) constitute only 2.8 % of the total population, they account for 46.4 % of electricity consumption. Further, motors of size greater than 20 hp constitute 17.2 % of the population and account for 91.5 % of electricity consumption. For the entire U.S., these numbers are skewed even more, primarily due to the large number of motors in households in the fractional hp and 1-5 hp size ranges which are estimated to be 600 million and 40 million units respectively. The percentage electricity consumption for motors in these size ranges would not be the same for India, mainly due to the smaller size and scale of our industrial plants compared to U.S. plants. However, the pattern would certainly be expected to be similar.

Factors affecting Motor Efficiency and Performance

Electricity consumption in a motor and the efficiency with which electrical energy is transformed into mechanical energy depend primarily on the intrinsic features of the motor itself, e.g. type, size, speed etc., the service conditions, the nature and type of application, e.g. continuous or intermittent duty, pumping or machine tool drive etc., and the matching of both the electric motor and the driven device to the application and the rest of the system. As mentioned earlier, the majority of electric motors are three-phase (polyphase) induction motors with squirrel cage rotor design, and the discussion in this paper would, by and large, pertain to this type of motors.

As a general rule, motor efficiency increases with motor size. A recent survey conducted by the Indian Standards Institution (ISI) amongst a few leading motor manufacturers indicates that the average efficiency at full load is 54 % for a 1/3 hp (0.25 kW) motor, 72 % for a 1 hp (0.75 kW) motor, 86 % for a 10 hp (7.5 kW) motor, and 91 % for a 50 hp (37 kW) motor. For the same horsepower rating, motors with higher speed generally have a higher efficiency at rated load.

Operation of motors at loads substantially different from rated load results in a drop in efficiency as well as power factor. Part-load performance characteristics depend on motor design and vary from motor to motor. For operating loads in the range of 50-100 % of rated load, the efficiency reduction is generally not very significant but the power factors drops considerably. Another disadvantage is the higher cost of a larger motor. Oversizing of motors, or overmotoring, is sometimes done deliberately to protect the motor from severe overheating when supply voltage exceeds rated voltage or fluctuates widely.

Motor performance is also affected considerably by service conditions such as actual voltage and frequency, and voltage unbalance across the three phases. Voltage unbalance can be more detrimental to motor performance and motor life than voltage variation. Indian standards specify that motors are to be designed for ± 6 % voltage variation; for agricultural motors, the specification is +6 to -15 %. In actual practice, supply voltage is very often beyond this range.

Another factor affecting efficiency is the practice of rewinding of burned-out motors. Through proper rewinding, motor efficiency can sometimes be maintained. In the majority of instances however, poor workmanship and poor rewinding practices result in loss in efficiency.

Proper selection of a motor with consideration to its duty cycle is also essential to minimise losses. In motors subjected to frequent starts and stops in highly intermittent service, losses due to acceleration also have to be considered. Motors with high torque

characteristics, despite having lower efficiencies, may show the least losses over the entire operating cycle in such applications.

Efficiency Improvement Measures

The major measures for improvement of motor efficiency are use of motors having higher efficiency, use of variable speed drives, proper matching of motor to load and application, and power factor improvement.

Energy Efficient Motors

Energy efficient motors are motors having higher efficiencies obtained by incorporating design improvements to reduce intrinsic motor losses. Historically, electric motors, particularly those in the 1-250 hp range, have been designed for minimum first cost by providing the least amount of active material, i.e. lamination steel, copper or aluminium wire, and rotor aluminium, necessary to meet the performance requirements. Energy efficient motor designs have a greater content of active materials, use superior quality materials and require closer tolerances in machining and manufacturing operations. As a result, costs of energy efficient motors are about 10-30 % more than those of standard motors. Appendix I briefly describes losses occuring in motors and design modifications usually made to reduce them in energy efficient motors.

Table 2 shows the nominal efficiency range and average nominal efficiency at full load for standard and energy efficient motors available in the U.S. ranging in size from 1 hp to 200 hp. The table shows that the range in efficiency for energy efficient motors is considerably less, and that the efficiency difference between standard and energy efficient motors decreases as motor size increases.

Use of energy efficient motors results in cost savings due to lower electricity consumption. In favourable situation, payback periods of less than one year can be obtained; typical payback periods are less

Table 2

Comparison of Full Load Efficiencies of Standard (NEMA Design B) and Energy Efficient Motors

hp	NEMA Design B Standard Motor: Nominal efficiency range	NEMA Design B Standard Motor: Average nominal efficiency	Energy Efficient Motor: Nominal efficiency range	Energy Efficient Motor: Average nominal efficiency
1	68-78	73	80-84	83
1.5	68-80	75	81-84	83
2	72-81	77	81-84	83
3	74-83	80	83.5-88.5	86
5	78-85	82	85-88.5	87
7.5	80-87	84	86-90.5	88
10	81-88	85	87.5-90.5	89
15	83-89	86	89.5-91.5	90
20	84-89	87.5	90-93	90.5
25	85-90	88	91-93	91.5
30	86-90.5	88.5	91-93	92
40	87-91.5	89.5	91.5-93	92.5
50	88-92	90	91.5-94	93
60	88.5-92	90.5	91-94	93
75	89.5-92.5	91	92-95	93.5
100	90-93	91.5	93-95	94
125	90.5-93	92	93-95	94
150	91-93.5	92.5	93-96	94.5
200	91.5-94	93	94-95.5	94.5
250	91.5-94.5	93.5		

Source: Andreas, J.C., Energy-Efficient Electric Motors, Marcel Dekker, New York, 1982.

than two years. The payback period depends on the application, cost of electricity, and the operating hours. Usually, motors operating less than 2000 hours/year are not good candidates for replacement by energy efficient motors. These motors are also difficult to justify in applications involving intermittent duty, high torque, and multi-speed or low-speed operation.

Variable Speed Drives

There are a number of applications where the load varies during operation, e.g. pumps and fans, where the output flow or pressure must vary in response to some other process variable. With a fixed speed motor as the driver, the control methods used are generally throttling or bypassing the flow. These methods are inherently inefficient. Conversion of such systems to variable speed systems wherein the motor speed itself is changed offers a large potential for energy savings.

Many types of variable speed systems are available. They include multi-speed motors, adjustable speed pulley systems, mechanical adjustable speed systems, eddy current adjustable speed drives, fluid drives, DC adjustable speed systems, AC variable frequency systems and wound rotors. Mechanical and fluid drive systems have been in use for many years. Considerable advances have been made recently in solid state electrical systems, in which speed control is obtained by varying frequency and/or voltage.

Selection of variable speed systems involves considerations of first cost, size, duty cycle, control features reqired, performance, reliability, maintenance etc. The savings depend on the application, and payback periods of 2-3 years are generally possible.

System Matching

Since motor losses are 5-25 % of input power, it is important to consider the complete system, including the electric motor, when determining system efficiency and potential for energy conservation.

By proper matching of all components in the system, losses can be reduced and therefore electricity consumption in the motor drive would also decrease. For example, in the case of agricultural pump sets, about 50-60 % savings are possible by proper selection and matching of motor, pump, suction pipe, discharge pipe and foot valve. Reduced extrinsic or system losses represent opportunities for conservation comparable to the conservation potential of equipment improvements.

Power Factor Improvement

Power factor is often discussed as an element of efficiency, although it is really a separate issue. Power factor improvement by installation of capacitors leads to reduction of line losses allowing greater utilisation of utility generation, transmission and distribution equipment.

Factors affecting Future Improvements in Motor Efficiency

There are a number of factors that would have an impact on any efforts towards raising the overall efficiency levels of electric motors. An understanding of these factors and their effects constitutes an essential input to the process of conceptualising and formulating policies and devising implementation strategies. Some of these factors are:

- Motor population characteristics
- Technical feasibility of efficiency improvement measures
- Economic viability of efficiency improvement measures
- Industry growth trends
- Manufacturers' attitudes and concerns
- Motor purchase channels
- Users' attitudes and concerns
- Standards
- Generic barriers to adoption of energy conservation technologies

Motor population characteristics, technical options, and their economic viability have already been discussed in previous sections;

however, a few points deserve recapitulation and further elaboration. Large motors which comprise a very small fraction of the total population consume a significant amount of electricity. These motors are already characterised by high efficiency levels. Considering their consumption, however, even a small increase in efficiency may still result in significant savings. In the case of small motors, electricity consumption is small, but the numbers are large and efficiencies are very low. A large increase in efficiency of these motors could lead to significant savings. In the intermediate range of motors, medium levels of efficiency improvement are possible. The electricity consumption is about as much as in large motors, but the number of motors is considerably more, and the maximum potential could therefore be expected in this range. Two noteworthy points that emerge from this discussion are that the savings potential would depend a great deal on the population characteristics and secondly, that different measures would perhaps be required to realise the savings potential in different groups of motors.

The discussion so far has largely been in the context of the existing motor population. However, the anticipated future mix of the population would also have to be considered. This would depend on the expected growth rates of different industries and the agricultural sector and the particular mix of motors unique to each.

The role of manufacturers would be very critical in any efforts to improve overall motor efficiency. New designs of motors optimised for energy efficiency would have to be developed, and considerable investments in new tooling and upgradation of manufacturing technology would be required. As mentioned earlier, optimising motor design for energy efficiency has repercussions on other performance characteristics; engineering tradeoffs are thus usually necessary with corresponding cost and performance implications. Frequently, manufacturers do not consciously optimise the design of each of their models in order to keep manufacturing costs low, e.g. the core design is standardised for motors in two or three horsepower ratings. The availability and quality of raw materials is very often a matter of

concern. How these and other such issues are resolved will ultimately determine what products manufacturers would be able to offer and also their cost. The extent to which manufacturers would respond and participate would depend on their capacity and willingness to improve or enhance their product line and their perceptions of market size, market growth and financial returns.

There are a large number of parties involved in motor sales - electric motor manufacturers, electric motor distributors/dealers, original equipment manufacturers (OEM's), engineering consulting firms, and end-users. The roles of each of these parties and their interactions during purchases of motors is of considerable interest since very often the end-user's involvement in motor specification, evaluation, and purchase is minimal or none at all. This is especially so in the case of equipment purchased from OEM's, e.g. manufacturers of machine tools, pumps, compressors, fans, appliances etc., who are usually more concerned about the equipment's initial capital cost than the running costs, and who would therefore generally opt for lower cost, less efficient electric motors. In the agricultural sector, the distribution channels are quite different compared to the industrial sector. Knowing the levels of motor purchases by different parties and through different channels would help in identifying target groups through whom maximum impact could be effected.

Another critical factor is the attitudes, practices and concerns of end-users relating to issues such as motor selection criteria, motor purchase procedures, operating and maintenance practices, rewind vs. scrap decisions etc. An understanding of current practices being followed and the rationale behind them is necessary to identify those that would aid and those that would impede proposed policies and strategies. For example, the relative importance assigned by industrial end-users to motor reliability and to price rather than efficiency, or deliberate oversizing of motors for overload protection, or inadequate attention during motor rewinding are all practices that would need to be recognised when devising suitable

policy instruments that would either reinforce such practices or seek to discourage and change them.

One possible mechanism to promote or enforce technological change could be through standards - whether through changes in existing standards or through new standards. There are several Indian standards in the field of electric motors, those most relevant here being IS:325-1978 Specification for Three-Phase Induction Motors (Fourth Revision), IS:8789-1978 Values of Performance Characteristics for Three-Phase Induction Motors and IS:7538-1975 Three-phase Squirrel Cage Induction Motors for Centrifugal Pumps for Agricultural Application. These standards cover the requirements and tests for three-phase induction motors and also specific performance characteristics such as minimum full load speed, maximum full load current, minimum breakaway torque and minimum product of efficiency and power factor. The specification for minimum product of efficiency and power factor at rated load for three-phase squirrel cage induction motors with IP44 type of enclosure is 0.368 for a 1/2 hp (0.37 kW) motor, 0.673 for a 10 hp (7.5 kW) motor, and 0.745 for a 50 hp (37 kW) motor. The standards do not include any specifications for efficiency, nor is efficiency required to be indicated on the name-plate.

IS:325-1978 includes a proviso by which manufacturers are encouraged to declare superior values of performance characteristics on the motor name-plate subject to verification through tests by ISI. To date, however, no manufacturer has done so.

About 45 percent of the motors manufactured in the country are covered under the ISI Certification Marks Scheme. Expansion of this coverage as well as upgradation of standards would be steps required to improve overall efficiency levels.

All the factors discussed above relate specifically to electric motors. In addition, other factors that would strongly affect improvement of efficiency levels in the industrial and agricultural sectors are generic barriers - technical, economic, attitudinal etc.

- to adoption and implementation of energy conservation measures. These would also need to be addressed suitably.

Policy Directions and Strategies

A wide spectrum of policy measures would be required to effectively address the various aspects of any approach to reduce the levels of electricity consumption in electric motors in the industrial and agricultural sectors. Broadly, these can be categorised as measures relating to technology upgradation, assistance and incentives to manufacturers, and assistance and incentives to users. These policy directions and strategies are described below. The primary agencies that would be involved in their formulation and implementation are indicated in brackets.

1. A thorough review of existing Indian standards relating to electric motors should be carried out to introduce and further upgrade specifications pertaining to or having a bearing on motor efficiency. Overall upgradation of standards, and particularly an increase in specified efficiency levels should be undertaken. This upgradation may be either in the form of additional standards for higher efficiency (energy efficient) motors, or the complete replacement of existing standards by those for energy efficient motors. A review of existing test procedures may also be necessary as part of this exercise. (Indian Standards Institution, Motor Manufacturers)

2. Mandatory labeling should be introduced, wherein the motor efficiency would be clearly indicated on the name-plate itself for the information of the user. Manufacturers should also be required to indicate efficiency information on all catalogues and technical literature. In the U.S., the National Electrical Manufacturers Association (NEMA) has adopted a standard for polyphase induction motors in which efficiency is denoted by a letter code corresponding to specified values of nominal efficiency and minimum efficiency, as shown in Table 3. For motors of a specific design, the nominal efficiency value represents the average value of a large population

Table 3

NEMA EFFICIENCY INDEX

Index Letter	Nominal efficiency	Minimum Efficiency
A	-	>95.0
B	95.0	94.1
C	94.1	93.0
D	93.0	91.7
E	91.7	90.2
F	90.2	88.5
G	88.5	86.5
H	86.5	84.0
K	84.0	81.5
L	81.5	78.5
M	78.5	75.5
N	75.5	72.0
P	72.0	68.0
R	68.0	64.0
S	64.0	59.5
T	59.5	55.0
U	55.0	50.5
V	50.5	46.0
W	-	<46.0

Source: U.S. Department of Energy, Classification and Evaluation of Electric Motors and Pumps, DOE/CS-0147, Washington D.C., February 1980.

and the minimum efficiency is the minimum value when operating at full load and at rated voltage and frequency. Although some ambiguities exist in this particular method, it illustrates the basic purpose of providing the user with efficiency information. Uniform test procedures for efficiency determination would also have to be laid down. (Department of Power, Advisory Board on Energy, Indian Standards Institution, Motor Manufacturers, Trade Associations)

3. Restrictions should be placed on the production and sale of motors that fail to meet minimum prescribed efficiency standards. A system of compulsory testing and certification should be introduced. Mandatory compliance with Indian standards for all manufacturers may also be considered. Currently, only 45 % of motors produced in the country carry the ISI mark; thus, 55 % do not necessarily meet IS specifications. A large fraction of these motors, especially in the small and fractional horsepower ranges, are manufactured in the small scale sector. These units would also have to be brought into compliance. (Ministry of Industry, Indian Standards Institution)

4. To upgrade existing designs of motors, manufacturers would be required to make sizeable investments both in R&D and design and in production facilities. Fiscal incentives should be provided to manufacturers to accelerate this process. These measures could include suitable concessions in financing in terms of lower interest rates or longer repayment periods, accelerated depreciation of capital equipment, customs duty relief etc. (Ministry of Finance, Financial Institutions)

5. In tune with the recent liberalisation of industrial licensing and technology transfer policies, motor manufacturers should be encouraged to make efforts to acquire modern and sophisticated designs and technologies. Technology transfer followed by rapid indigenisation should be ensured in such efforts. (Ministry of Industry, Directorate General of Technical Development)

6. In the case of manufacturers in the small scale sector, technical assistance should be provided for upgradation of technology, as it

would be beyond the resources and means of any individual manufacturer to do so. This assistance would cover areas such as specifying and standardising designs and manufacturing technology, material specifications, equipment specifications, design of tools, jigs and fixtures etc. (Ministry of Industry, National Industrial Development Corporation)

7. Priority areas for R&D should be identified and appropriate R&D programmes initiated. These projects should be dovetailed with the technology transfer and assimilation process for technologies acquired from foreign countries for maximum benefits. R&D activities to address the technology upgradation needs of the small scale sector would be especially significant. Demonstration projects should also be taken up. (Ministry of Science and Technology, National Research Laboratories, Central Power Research Institute, National Research and Development Corporation)

8. Technical assistance and services should be made available to industries to enable them to systematically survey their electric motors, determine the measures required to reduce electricity consumption, and assist in implementation. These services could be provided through a special agency created for this purpose or through existing institutions. Efforts should also be made to encourage, develop and strengthen such expertise at all levels of the engineering profession. (Department of Power, National Productivity Council or other organisations providing similar services, Central Electricity Authority, State Electricity Boards)

9. In the agricultural sector also, technical assistance and services should be made available to farmers for rectification and improvement of existing pump sets and for system design and equipment selection for new pump sets. Demonstration project activities should be considerably enhanced. (Rural Electrification Corporation, National Agricultural Bank for Rural Development, State Electricity Boards)

10. In order to assist users in properly specifying and selecting the motor most suited to an application and in using it properly, a code of practice providing guidance on specifications, selection, installation, operation and maintenance of electric motors and recommending good engineering practices should be prepared and disseminated widely. This application manual should also address aspects of system design, matching and integration. A recently issued standard by ISI, IS:10804-1986 Recommended Pumping System for Agricultural Purposes (First Revision), covers some of these aspects. The manual should also contain complete comparative catalogue data on all available motors to provide baseline information for motor selection. Apart from providing guidance to users, such manuals could also serve as course material in professional education and training programmes. Compilation and regular updating of data on performance of electric motors made by different manufacturers in normal and abnormal service conditions should also be undertaken. This would again serve to provide users with information which otherwise may require a lot of time or resources. (Department of Power, Motor Manufacturers, Engineering Consulting Organisations, Indian Standards Institution)

11. Fiscal incentives should also be made available to users for energy efficiency improvement measures including motor replacement. These could include soft loans, subsidies or grants, tax credits, accelerated depreciation provisions etc. (Ministry of Finance, Financial Institutions)

12. Institutional credit to industries and farmers should be made available only to buyers of equipment which conform to prescribed standards. (Financial Institutions, National Agricultural Bank for Rural Development)

13. Reporting systems should be devised to monitor the sales and penetration of energy efficient motors. This would help in assessing the effectiveness and impact of applicable policies and suggest areas for policy changes. (Directorate General of Technical Development, Trade Associations)

14. Energy pricing policies should also be considered. In the agricultural sector, flat rates of tariff act as a considerable disincentive for energy conservation. (Department of Power, State Electricity Boards)

The policy directions and strategies outlined above would all act to raise the efficiency levels of the electric motor population. The nature and magnitude of the effects of each of the suggested measures would vary. Careful analysis of the influence mechanisms of each policy, implementation methods and problems, costs of implementation, and anticipated effectiveness and benefits would be necessary to select the most effective and suitable combination of policies.

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Appendix I

Motor Losses and Energy Efficient Motors

The efficiency of an electric motor is the ratio of the mechanical energy delivered at the rotating shaft to the electrical energy input at its electrical terminals. The efficiency with which this transformation takes place is determined by intrinsic losses occuring within the motor; these losses can be reduced only by motor design changes.

Losses can be categorised into two groups - no-load losses and load losses. No-load losses, as the term implies, occur even when the motor is unloaded, and are relatively constant over the entire load range. These losses are magnetic core losses and friction and windage losses. Load losses vary as motor load varies and consist of stator I^2R losses, rotor I^2R losses, and stray load losses.

Magnetic core losses consist of eddy current losses and hysterisis losses in the rotor and stator magnetic structure. These losses are independent of load. Friction and windage losses are caused by the friction in the bearings of the motor and the windage loss of the ventilation fan and other rotating elements of the motor. Since motor speed variation from no-load to full-load is small, those losses are relatively constant. I^2R losses are caused due to current flowing through a resistance. Stator I^2R losses are a function of (the square of) the current flowing in the stator winding and the stator winding resistance. Rotor I^2R losses arise similarly. Since these losses vary as the square of the current, they are generally small at no load, but increase significantly at full load. Stray load losses are residual losses arising from a number of elements. They are difficult to measure directly or calculate, and are generally assumed to be proportional to the square of the output.

Design changes are required to reduce these intrinsic losses. Magnetic core losses can be reduced by making the laminated core with thinner gauge steel to reduce eddy current losses and by using silicon grades of electrical steel to reduce hysterisis losses.

Friction and windage losses can be minimised by better bearings, proper maintenance of bearings, and design of smaller and more efficient fans. Since windage losses are associated with the amount of ventilation required to remove heat generated by other motor losses, they would be reduced as other losses are reduced. I^2R losses can be reduced by decreasing conductor resistance or line current. Conductor resistance can be decreased by increasing conductor cross-section and/or utilising high conductivity material. Current reduction is most readily accomplished by decreasing its magnetising component, which involves decreasing operating flux density and/or shortening the air gap. Stray losses are affected by factors such as air gap length, number of slots, slot geometry, leakage flux, manufacturing process considerations etc.

Making modifications for efficiency improvement is not just a matter of making a few simple design changes but requires a balance among several complex and interrelated design parameters. For example, I^2R losses can be reduced by decreasing the magnetising component of the current by lowering the operating flux density and/or reducing the air gap. However, lowering operating flux density has the effect of reducing motor torque which may not be acceptable. Improving the power factor of the motor also requires reducing the magnetising current and would hence cause a decrease in motor torque. The level of difficulty and consequently the cost of improving electric motor efficiency increases as the horsepower rating increases.

Energy efficient motors generally contain more active materials as well as superior quality materials. They have a longer stator and rotor, higher grade low loss steel laminated core, more copper and aluminium, special winding designs, and optimally designed slots, air gap etc. Due to these features, costs of energy efficient motors are about 10-30 % higher than standard motors.

PETROLEUM CONSERVATION IN INDIA

PROBLEMS AND PROSPECTS

(Background Paper)

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1. Background

India is a net oil importer, whose oil import bill has increased substantially since the early 1960s. Until 1980/81, this occurred despite an increase in relative self-sufficiency in oil supplies, from a mere 6% in 1960/61 to about 30-40% during the 1970s. Although the net oil import bill is reported to have reduced substantially since 1980/81 (Table 1), this is due largely to: (i) a rapid increase in indigenous crude production as self-sufficiency in oil supplies increased to over 60% in 1984/85; and (ii) falling oil prices in the international market.

However, the rapid increase of indigenous crude oil supplies, as witnessed during the Sixth Five Yeaar Plan (FYP) period, is not anticipated to continue even during thee Seventh FYP period (1985/86-1989/90). This is evident from the fact that indigenous crude production increased from about 10.5 million tonnes (MMT) in 1980/81 to about 29 MMT in 1984/85; while the target for 1989/90 is just 34.53 MMT (Seventh Plan Document, GOI, 1985). On the other hand, if demand for petroleum products does increase from 38.63 MMT in 1984/85 to 52.67 MMT in 1989/90 (as projected in the Seventh Plan Document), it is clear that relative self-sufficiency in oil supplies will reduce considerably during the Seventh FYP period itself.

And the uncertainties in the international oil market -- which can affect not only the oil import bill, but also the viability of investments in refinery capacity -- do indicate that steps be taken to reduce the implications of the vagaries of international oil price movements, and in particular, the interaction between crude and product markets.

Table 1 : Petroleum Imports

	Net Crude Oil Imports		Net Product Imports Imports		Total Petrole Import Bill	
	'000 tonnes	Rs.million	'000 tonnes	Rs million	'000 tonnes	As % expo
1970/71	11683	1067	752	252	1320	8
1973/74	13855	4160	3387	1165	5324	21.
1976/77	14048	11759	2550	2413	14173	2[illegible]
1979/80	16121	21875	4636	10584	32459	50.
1980/81	16248	33490	7253	19091	52581	78
1981/82	14460	35402	4829	14380	49782	65.
1982/83	12397	29804	4233	14202	44005	57.
1983/84	10445	23100	2856	9138	32237	38.
1985/85**	7164	18672	5159	16599	35270	37.

* Total Exports net of crude and petroleum product exports.

** Provisional.

Source : Indian Petroleum and Petro-Chemical Statistics, 1984/85, Departr Petroleum, GOI.

Against this background, it becomes meaningful to study the scope and potential for petroleum demand management in India. It has been noted by several researchers, and recognized by energy planners in the Government, that India's efforts at implementing

petroleum conservation measures (during the post-1973 period) have not been as successful as those of several other developed countries. And it is also recognised that the pricing mechanism alone cannot achieve the desired objective of conservation.

It would be useful at this stage to look at some international comparisons on the use of petroleum and petroleum products in the Asian countries. Table 2 below shows the share of oil in total commercial energy demand in some selected countries of Asia.

Table 2 : Shares of Oil in Total Commercial Energy Demand (percent)

	1973	1983
Bangladesh	52*	40
China	19	19
India	33	30
Indonesia	87	76
Korea	64	59
Malaysia	94	89
Pakistan	47	35
Philippines	96	82
Taiwan	69	59
Thailand	91	78

* 1977

Even though India's dependence is not particularly high, it is interesting to observe that countries like Korea, Malaysia and Taiwan have reduced their dependence on oil somewhat faster than India has been able to achieve.

Despite the increase in oil prices between 1973 and 1983, per capita consumption of oil in India has gone up, as is the case for most other countries of the region. This is brought out by figures presented in Table 3.

Table 3 : Oil Demand per Capita (TOE per 1000 persons)

	1973	1983	AAGR
Bangladesh	-	15	-
China	57	83	3.8%
India	43	54	2.3%
Indonesia	75	139	6.2%
Korea	413	699	5.3%
Malaysia	412	661	4.7%
Pakistan	42	63	3.9%
Philippines	260	213	-2.0%
Taiwan	627	966	4.3%
Thailand	197	226	1.4%
Average	**73**	**104**	**3.5%**

The case of the Philippines, of course, is the only example in this group of countries where the actual

decline in oil consumption per capita was achieved between 1973 and 1983.

As is discussed later in this paper, there appears to be a certain inevitability in the increase of oil consumption in the Indian economy, particularly since there have been failures of supply in other forms of energy. There is nevertheless considerable scope of conservation measures, which need to be taken in hand urgently if we are to manage effectively our growing dependence on oil and oil products.

Although the inability to implement conservation measures to the desired degree may be attributed to several causes, it is important to review the involvement of various institutions in this area. Perhaps the best organised effort in this regard is that by the Petroleum Conservation Research Association (PCRA), which was established in 1975; and which has made significant progress in popularizing the concept of petroleum conservation in both the organised sector, as well as with other categories of consumers. The National Productivity Council (NPC) also does consulting work for fuel efficiency improvement at the plant level, and conducts seminars (often jointly with other public sector companies) for industry managers and engineers. Despite this, relatively few industries have taken steps to improve the fuel efficiency of their operations. With an intention to find means to accelerate the

adoption of energy conservation -- and particularly, petroleum conservation -- measures, an Inter-Ministerial Working Group was set up in 1981, whose recommendations have formed a basis for the report on Energy Conservation of the Working Group on Petroleum for the Seventh Plan.

2. Sectoral Consumption of Petroleum Products

The demand for petroleum products increased rapidly from about 17.9 MMT in 1970/71 to 38.63 MMT in 1984/85. This was due partly to a rise in economic activity.[1)] However, persistent shortages in coal supply and utility electricity -- particularly during the past ten years -- have also resulted in an increased demand for refined products.[2)] Furthermore, certain pricing policies, such as subsidizing kerosene, also contributed to a rise in kerosene demand for household cooking, by making soft-coke production unprofitable. And as the Government did not allow the differential between consumer prices of kerosene to become too

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1) GDP at factor cost grew at an average rate of 3.75% per annum during the fifteen-year period 1970/71 to 1984/85, while the consumption of refined products increased much faster, at the rate of 5.65% per annum during the same time period.

2) For instance, shortages of non-coking coal for industrial consumers made them rely on furnace oil despite a Government policy to encourage oil substitution in this area. Similarly, electric power shortages prompted several industrial and commercial establishments to instal captive diesel generating sets; and agricultural consumers to instal diesel pumpsets for standby use.

high,[3] certain private automobile users have preferred to retrofit their petrol driven cars by even inefficient diesel engines. Such a conversion has been privately profitable largely because petrol prices include a large tax component.[4] Other reasons, such as a rising share of road traffic, rapidly rising use of diesel in buses and trucks, dieselization of railways, increasing reliance on tractors for land preparation in agriculture etc. also contributed to a rapid rise in consumption of petroleum products.

Although the data base on the sectoral consumption of petroleum products is not complete (Table 4), it is clear that the transport sector has accounted for the maximum consumption of petroleum products in recent years. Most of this consumption is accounted for by road transport. In fact, fuel consumption for road transport -- both freight and passenger -- has increased rapidly largely due to the inability of the railways to increase the traffic through-put.

The industrial sector (including power generatioon by utilities and non-utilities) is the second largest consumer of petroleum products. It may be noted that a

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3) Apparently to ensure that diesel is not adulterated by kerosene, and that subsidized kerosene in fact does become available to low income households.

4) See R.Bhatia, Energy Pricing in Developing Countries: Role of Pricing in Investment Allocation and Consumer Choices, in C.M.Siddayao (Ed.), Criteria for Energy Pricing Policy, Graham and Trotman Ltd., 1985.

substantial -- though unknown -- quantity of HSD is consumed for power generation in captive units in both industrial and commercial establishments; which only reflects the unreliability of the power supply in several states. However, even for industrial process heating and steam generation, there is substantial potential for conservation.

The residential sector accounts for substantial consumption of kerosene. A part of the kerosene used for domestic cooking and lighting is also used in commercial establishments -- although no reliable data are available.

As for the agriculture sector, although the data base is inadequate, the consumption of petroleum products is anticipated to have increased rapidly during the past decade or so. This is evident from data on the population of diesel pumpsets and land preparation equipment (Table 5).

On the basis of the discussion above, it is clear that there is considerable scope for petroleum conservation in India. Technical/technological improvements, financial incentives, policy initiatives and legislative measures that would help in implementing conservation measures in the various sectors are discussed in subsequent sections.

Table 4 : Sectoral Consumption of Petroleum Products

	1979/80	1981/82	1983/84
A. - Total Consumption (All Products)	29883	32523	35841
- Total Consumption@ (Major Products)	27405	29927	33428
	(91.7)	(92.0)	(93.3)
B. Transport Sector	11768	12645	14636
	(39.4)	(38.9)	(40.8)
b.1 Road Transport	9286	10150	11791
	(31.1)	(31.2)	(32.9)
- Motor-Spirits	1490	1599	1891
- HSD	7765	8525	9841
- LDO	2	2	8
- Furnace Oil	29	24	51
b.2 Railways	924	983	1162
	(3.1)	(3.0)	(3.2)
- HSD	879	902	1105
- LDO	5	6	5
- Furnace Oil	40	75	52
b.3 Water Transport	414	384	475
	(1.4)	(1.2)	(1.3)
- HSD	60	78	103
- LDO	92	89	89
- Furnace Oil	262	217	283
b.4 Air Transport	1144	1128	1208
	(3.8)	(3.5)	(3.4)
- ATF	1144	1128	1208
C. Industrial Sector	11268	11764	12309
	(37.7)	(36.2)	(34.3)
- LPG	56	67**	86**
- Naphtha	2413	2963	2804
- HSD	1097*	1129	1432
- LDO	1096*	910	969
- Furnace Oil	4321	3831	3693
- LSHS/HHS	2285*	2864	3325
D. Residential Sector	4204	5117	6184
	(14.1)	(15.7)	(17.3)
- LPG	332	424	660
- Kerosene***	3872	4693	5524
E. Agriculture Sector	144	401	299
	(0.5)	(1.2)	(0.8)
- HSD	NA	198	119
- LDO	NA	30	26
- Furnace Oil	144	159	128
- LSHS/HHS	NA	14	26
F. Other Sectors	21	NA	NA
- LPG	21	NA	NA
- Other Products	NA	NA	NA

Notes :

Figures in parenthesis denote percentage of consumption to total consumption to all petroleum products

@ Includes 9 major products : LPG, naphtha, motor-spirits, ATF, kerosene, HSD, LDO, Furnace Oil and LSHS/HHS.

* Includes consumption in agriculture sector also.

** Includes consumption in commercial sector also.

*** Includes consumption in commercial sector also.

F. Plantation/food (including food processing industries). Excludes HSD use in tractors, which is probably included in transport sector. Also excludes HSD/LDO use in diesel pumpsets, which is probably included in the industrial sector (along with DGS & D industries).

Source : Indian Petroleum and Petrochemical Statistics, Department of Petroleum, GOI, various issues.

Table 5 : Farm Mechanization

	Numbers ('000)		Per million hectares of gross cropped area	
	Diesel Pumpsets	Tractors	Diesel Pump sets	Tractors
1970	NA	100	NA	610
1975	1800	250	10400	1520
1979	2700	410	15460	2350
1980	2900	473	17100	2790
1981	3100	520	17890	3000
1982	3300	597	19020	3440
1983	3500	663	20350	3850

Source : Centre for Monitoring Indian Economy, Basic Statistics Relating to the Indian Economy, Bombay, August 1984.

3. Petroleum Conservation in the Transport Sector

As road and rail are the two major modes of transport in India, issues pertaining to petroleum conservation in only these two modes are addressed below.

3.1 <u>Road Transport</u>

Several factors have resulted in a rapid increaase in fuel consumption for road transport, the most important of which are : (i) increasing inadequacies in the railway system. This has increased the relative share of freight traffic in trucks and passenger traffic in buses and other road vehicles; (ii) rapid expansion of the road network, which has been extended to several rural areas; (iii) poor road surface conditions on many such roads; and (iv) the fact that the road pavement widths have not been widened adequately enough to handle increased traffic -- even on several parts of the national highway system. In addition, vehicle design, types of tyres used, extent of overloading, and speed at which vehicles are driven, have also contributed to the rather high consumption of petrol and diesel.

The Report of the Subgroup on Petroleum Conservation for the Seventh Plan points out that an improvement in road conditions can have maximum implications for fuel economy, even if there are no significant improvements in the design of vehicles used on Indian roads. The implications of improving the type of surface are presented in Table 6. Additional improvements are possible if single or intermediate lane roads with bi-directional traffic are widened to two lanes -- because this would reduce the deceleration and acceleration time of vehicles. The Subgroup estimates

that such improvements would cost approximately Rs. 53 billion, and result in a fuel savings of about Rs. 5 billion per annum (excluding taxes).

Fuel consumption norms presented in Table 6 are for the types of vehicles in use in India until 1982. Until that time, two makes of 2-wheelers had also captured a large share of the market for inexpensive private passenger transport vehicles -- in fact, the number of 2-wheelers now far exceeds the number of cars in the country. The petrol consumption norm for both these vehicles was 30-35 km/litre at an optimal speed of about 35 km/hour on asphaltic concrete surface roads.

However, since 1983, fuel efficient indigenously manufactured cars, jeeps and 2 - wheelers have been introduced. These designs incorporate more up-to-date technology than the ones manufactured before; largely in the form of :

(i) <u>2 Wheelers</u> : Automatic and efficient transmission systems, use of lighter materials, higher rpm engines which give a high output per cc, electronic ignition, adequate cooling arrangements, efficient filtering of inlet air, 4-stroke engines, and so forth.

(ii) <u>Motor Cars</u> : Stream lined body designs, use of lighter materials, improved ignition and transmission systems etc.

In fact, there is scope to improve the efficiency of the older designs manufactured in India as well,

perhaps by optimizing the compression ratio. This may be possible if the manufacturers are given adequate financial incentives for carrying out in-house R & D activities. And designs may also be developed for higher compression engines -- particularly because indigenous production of mogas 89 (instead of the currently used mogas 87) will become possible as secondary refining facilities are expanded.

Table 6 : Fuel Consumption Norms in Road Transport Vehicles

Surface Roughness (mm/km)	Surface Type	Fuel Consumption Expressed as % of fuel Consumption on the Best Surface				
		Ambassador Car	Premier Padmini	Diesel Jeep	Tata Truck	Ashok L[illegible] Beaver [illegible]
3000	Asphaltic Concrete	100	100	100	100	100
5000	Premix Carpet	102	106	104	102	10[illegible]
6000	Surface Dressing	102	108	105	103	106
8000	Good Water-bound Mecadem	104	114	110	105	11[illegible]
12000	Poor Water-bound Mecaem	107	125	116	108	11[illegible]
15000	Gravel, Earth	110	133	122	111	12[illegible]
Memo Items						
a. Type of fuel		Petrol	Petrol	Diesel	Diesel	Die[illegible]
b. Speed at which fuel efficiency is maximum on Asphaltic Concrete (km/hr)		40	40	35	45	3[illegible]
c. Fuel Consumption at Optimal Speed (cc/km)		75.88	71.02	69.6	133	305
or (kilometres/litre)		13.2	14.1	14.4	7.5	3[illegible]
or (toe/million vehicle-km)		59	55	61	116	26[illegible]

Notes : Mogas 87; 1405 litres/tonne; 11135 kCal/kg. HSD ; 1210 litres/ 10790 kCal/kg. 1 toe = 10.2 million kCal.

Source : Central Road Research Institute, Road User Study in India, New[illegible] 1982.

It is observed that although the heavy automobile manufacturers have made efforts to improve fuel efficiencies in recent years, considerable scope for improvements still remains. Engines of the same horse-power ratings are in general used for both trucks and buses. The engine suits the requirements for trucks which are often overloaded, but not of buses. The Subgroup on Petroleum Conservation had recommended in 1984 that Ashok Leyland and TELCO must collaborate more closely with State Road Transport Undertakings and other agencies in order to understand the operating conditions for buses -- and consequently, to evolve better suited engine designs for buses. Other design factors, such as the use of radial tyres and turbo-chargers on new vehicles were also recommended.

Other factors that would help to improve energy efficiency include :

(i) Driving at Optimal Speeds. If the vehicle is driven too slow or too fast compared to optimal speed, the fuel consumption can be much higher than optimal. This calls for a comprehensive training of drivers in fuel efficiency aspects of driving.

(ii) To have better quality spare parts in garages, and to train mechanics properly.

3.2 Rail Transport

Diesel consumption for rail has also increased rapidly since the early 1970s (Table 7), for two major reasons : (i) a decision to gradually phase out steam locomotives, which are highly energy intensive; and (ii) a slower than anticipated increase in electric traction and track electrification. The latter reason is due partly to the fact that rail traffic has not expanded as rapidly as desired -- a feature which makes track electrification uneconomic. The Seventh Plan Document notes that rail track electrification is economic only if the traffic density exceeds 20 million gross tonne - km per route-km each year.

Diesel consumption intensity in the railways does not appear to have followed any trend (Table 7). However, it may be noted that it is less energy intensive than any other vehicle used for road transport (Table 8). Therefore, a case may be made to expand the railways' traffic throughput capacity more rapidly than during the past decade.

Table 7 : Trends in Diesel Locomotion and Diesel Consumption in Railways

	Units	1970/71	1973/74	1976/77	1979/80	1982/83
Total Traffic	(billion gross t-km)	390.34	377.14	469.28	468.77	521.87
.1 Freight and non-suburban pass. traffic	"	381.43	366.28	456.50	455.08	507.23
- steam	%	47.6	39.3	30.9	23.3	15.6
- diesel	%	36.0	43.1	46.7	54.7	57.4
- electric	%	16.4	17.6	22.5	22.0	27.0
.2 Suburban pass. traffic	(billion gross t-km)	8.91	10.86	12.78	13.69	14.64
. Diesel Consumption	(thousand kilolitres)	569	681	847	981	1227
. Intensity of diesel consumption	(toe/ billion gross t-km)	3622	3771	3473	3445	3684

ource : Railway Board, Annual Statistical Statements, various issues.

Table 8 : Comparison of Fuel Consumption, Intesity for Propulsion

Mode	Occupancy	Intensity
. **Passenger Transport***		
Urban bus	50	4.5
Regional bus	50	4.1
Motor Car	2	29.5
2 - Wheeler	1	15.4
Diesel Train	900	3.3
. **Freight Transport****		
Diesel Truck	-	39.2
Diesel Train	-	4.1

Intensity in toe/million passenger-km.

* Intensity in toe/million tonne-km.

ource : Government of India, Report of the National Transport Policy Committee, 1980.

4. Petroleum Conservation in the Industrial Sector

Apart from captive generation, which is usually diesel based, oil is used in industry largely for steam generation and process heating. Only in the fertilizer and petrochemical industries, is naphtha used as both fuel and feedstock[1]. The prospects for oil conservation in industry are discussed below :

4.1 Boilers and Furnaces

According to Desai (1981)[2], the use of furnace oils for steam generation and for other purely thermal uses was not associated with a higher fuel efficiency than was the use of coal. Furnace oil often found markets near refineries, away from coal fields, and in industries where it offered some non-price advantages over coal, for example, higher production capacity, greater process controllability, ready availability, no ash disposal problem, and so forth. Relative prices of furnace oil and non-coking coals have often been of little relevance.

Although there was a drive to substitute furnace oil by coal after the 1973 oil crisis, this campaign ran aground in 1976 as coal shortages began to emerge.

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1) Some ammonia production plants also use fuel oils as feedstock and fuel.

2) Ashok V.Desai, Interfuel Substitution in the Indian Economy, Resources for the Future, Washington, D.C. 1981.

ICICI (1983) notes that several industries now prefer to instal the more expensive multi-fuel fired boilers, which may run on either fuel, depending upon availability.

For the reasons pointed out above, it would not be correct to draw judgments on petroleum consumption intensities and efficiency improvements on the basis of trends in furnace oil consumption data alone. It may be better instead to review the efficiency factors and performance of industrial boilers and furnaces.

Table 9 presents data on boiler efficiency in selected industries. The substantial differences in boiler efficiencies may be due to several reasons, including boiler design and vintage, the type of heat recovery equipment employed, the extent and type of control instrumentation used, and so on. ICICI (1983) also recommended the following measures to help improve the overall thermal efficiency of boilers.

(i) Some of the short-term measures are :

(a) to instal economisers and/or air preheaters in the boilers which do not have such equipment to recover heat from the flue gases;

(b) to instal CO_2/O_2 analyzing equipment, which would help to reduce the high losses in flue gases, which often result from excess air supply;

(c) to instal thermo-compressors, which can be used to recycle the heat that is otherwise lost through low pressure steam and vapours.

(ii) Some of the long-term measures are:

(a) to replace the existing old boilers with new boilers which generate steam at a high pressure, and are coupled to a turbo-alternator set for electricity generation.

(b) to instal waste heat boilers.

Likewise, for oil fired industrial furnaces, which also have rather low operating efficiencies, except in the petrochemical industry (Table 9), the ICICI recommended better "house-keeping", the use of heat recovery equipment (recuperators or regenerators), installation of on-line flue gas analyzers, and use of better refractory/insulation, as some of the measures to help improve overall thermal efficiency.

Table 9 : Boiler and Furnace Efficiency in Selected Industries

Industry	Type of fuel	Efficiency Range (%)
A. **Boilers**		
Aluminium	Oil/Coal	60-70
Chemicals	Oil	75-85
Fertilizer	Oil/Naphtha	75-85
Man Made Fibres	Oil	75-80
Paper	Oil/Coal	60-70
Petrochemicals	Oil/Naphtha/Gas	85-93
Textiles	Oil/Coal	50-65
B. **Furnaces**		
Forging	Oil	5-15
Glass	Oil	15-20
Petrochemicals	Oil	40-60

Note : Oil refers to fuel oil.
Source : Industrial Credit and Investment Corporation (ICICI) Proceedings of a Workshop on Energy, 1983.

The Subgroup on Petroleum Conservation for the Seventh Plan also points out that several financial incentives and administrative initiatives may also be required to accelerate the implementation of the petroleum conservation objectives of the Indian industry. In particular, the need to establish an Office for Energy Conservation (say, in the Ministry of Energy, or Industry) was highlighted. This Office would be concerned primarily with the task of enacting and reviewing policy regarding conservation, as also for monitoring progress in this area. The latter function would be performed more in conjunction with other agencies which could assist in "Energy Audit" services to small and medium scale industries as well. This Office could also provide adequate financial support for implementing conservation programmes by managing a "Revolving Fund" of Rs. 1000 crores (Rs.10 billion); and by initiating R & D programmes in various national and regional laboratories, educational institutions, industrial establishments, etc.

It is important to recognize that financial support is necessary, because industry managers have often found it relatively difficult to raise funds for conservation projects. Moreover, some industry managers may not be very keen to invest in conservation projects if energy costs are only a small fraction of the total production cost.

4.2 Naphtha Consumption for Ammonia Production

From a nominal capacity of 85,000 tonnes per annum of the nutrient "nitrogen" (for fertilizer production) in 1951/52, the production capacity of straight nitrogenous fertilizers reached about 5.4 MMT in 1984/85. A large share of this production capacity is based on naphtha. For instance, 41% of urea production capacity in 1984/85 was urea based; during the 1970s, it was much more. And over 70% of total naphtha consumption in the country is accounted for by the fertilizer industry -- about 55% of which is consumed as a feedstock (for hydrogen production at the ammonia synthesis stage), and the rest as fuel.

It therefore becomes interesting to review the trends in naphtha consumption intensity. Recent advances in process technologies and catalysts have resulted in better consumption norms -- during the 1970s, the naphtha consumption norm per tonne of ammonia guaranteed by various technology suppliers has reduced from 0.9-1.0 tonnes to 0.8-0.85 tonnes. However, these norms, as guaranteed by the technology suppliers, can be achieved only if the plants are properly maintained and capacity utilization is 100%. The fact that capacity utilization has not exceeded 70% until now (Table 10), suggests that there remains significant scope for reducing naphtha consumption intensity further.

Table 10 : Capacity Utilization for "Nitrogen" Production (%)

1970/71	67%
1980/81	46%
1981/82	61%
1982/83*	66%
1983/84*	67%
1984/85*	67%

* Naphtha accounted for 77.1% of overall energy consumption in the fertilizer industry in 1982/83. The corresponding figures for 1983/84 and 1984/85 are 76.1% and 74.4% respectively.

Source : Hanagudu and Kothari, Energy use in Fertilizer Industry (Draft Report), Tata Energy Research Institute, October 1986.

5. Petroleum Conservation in the Agricultural Sector

With the rapid rise in the number of diesel pumpsets and tractors since the early 1970s (Table 5), there is strong evidence that diesel consumption for agricultural purposes has increased rapidly during the past decade or so. While diesel consumption efficiency in tractors may be improved essentially in a way similar to that for other road transport vehicles (section 3.1), efficiency improvements of diesel pumpsets should be considered here. It is at first important to recognize that a certain (unknown) fraction of diesel pumpsets may be used only as stand-by units by farmers who have electric pumpsets.

The Subgroup on Petroleum Conservation notes that the scope for increasing fuel efficiency of diesel pumpsets is substantial. It identifies several problems

in the existing pumpsets: (i) proper sized pumps are not usually installed, and the water lift head range in which a pump operates efficiently is very different from actual operating conditions; (ii) there is no proper maintenance; and (iii) there are other problems, such as the delivery pipe may be either too short or too long, the suction pipe may have an air leak, certain pipe fittings may be used even when not required, footvalves and strainers may have high resistance which increases friction losses, and so forth.

Although NABARD extends loans to farmers to replace defective pipes and footvalves and other components, this scheme has not taken off, primarily because the benefits of such an investment have not as yet been demonstrated adequately. The Subgroup on Petroleum Conservation, therefore, recommended that a comprehensive plan of activities should be evolved so as to accelerate the pumpset rectification programme. The activities, which would need to be initiated simultaneously require : (i) to collect information on rate of discharge and static head by an actual measurement prior to rectification; (ii) to arrange at least one demonstration of rectification measures in all villages having more than ten pumpsets; (iii) to educate pump owners about the energy drain mechanism in a pumpset, as well as on benefits from pumpset rectification; (iv) to train manpower which can offer

advisory services to a farmer; and (v) to establish a channel through which necessary spare parts and materials can be distributed at a fair price.

According to the Subgroup, top priority should be accorded to popularizing the use of low-resistance footvalves -- perhaps by offering a direct subsidy initially. An exemption of sales tax and excise duty may also be considered. It also recommended that the ISI should establish standards for footvalves, and also other components.

As for new pumpsets, the Subgroup also recommended that the ISI should establish a code of practice for installing them; and that the manufacturers be made responsible for the selection of a suitable pumpset. In order to deter the farmers from purchasing non-ISI certified sets (which are relatively cheaper by about Rs.500), the Subgroup recommended that a subsidy to the tune of Rs.500 per pumpset be granted on installing an ISI certified set.

6. Petroleum Conservation in the Residential Sector

As kerosene consumption accounts for a major proportion of petroleum product consumption in the residential sector (Table 4), the discussion below is confined solely to means for improving the efficiencies of kerosene fueled devices. According to the Subgroup

on Petroleum Conservation, 60-65% of kerosene consumption is for domestic cooking (mostly in urban areas), and 30-35% for lighting (mostly in rural areas). As an average household uses only 15-20 litres per month for cooking, and 1-2 litres for lighting, it is evident that the number of target consumers is indeed very large.

6.1 <u>Kerosene for Cooking</u>

The nameplate efficiency of most kerosene stoves is 40-45%, while that of the 'Nutan' stove (one of the few stoves designed for higher thermal efficiencies) is 60%. Although over 1 million 'Nutan' stoves are reported to have been sold since 1976 -- the year when the 'Nutan' stove was introduced -- there has been no systematic survey to gauge its performance, so far. Therefore, it is necessary that a suitable survey be organized, not only to assess the performance of 'Nutan' and other fuel efficient stoves, but also to estimate the potential market for such efficient, but relatively expensive, stoves.

In order to promote the sale of fuel efficient stoves, the Subgroup on Petroleum Conservation recommended that normal marketing channels be used, and that the manufacturers themselves be responsible for advertising and selling them. In fact, the concept of "new stoves for old", as for LPG burners, may also be tried.

The Subgroup also recommended that it be made mandatory for all kerosene stove manufacturers to improve their designs to conform to the ISI specification of 60% thermal efficiency, within a span of one year or so. To encourage manufacturers for improving their designs, the Subgroup suggested that arrangements be made that the cost of improving the design gets reimbursed from the Oil Industry Development Fund (OIDF). In addition, the Subgroup also recommended that housewives be made aware of the advantages of using pressure cookers and other pots of suitable design and material.

6.2 Kerosene for Lighting

The Subgroup noted that kerosene lanterns, that are in use today, have an illumination efficiency of only 1% -- which is very poor when compared to incandescent bulbs (with about 10% efficiency) and fluorescent tubes (with about 20% efficiency and higher). As for over a century, no R & D effort has been directed towards improving the performance of a hurricane lantern, the Subgroup identified two areas where further work could probably lead to better illumination efficiencies and output: (i) to develop an efficient burner; and (ii) to improve the mantle. It is important to note that considerable quantities of

kerosene can be saved even if the illumination efficiency improves to only 2%.

7. Overview

The discussion above reveals that there is considerable scope for improving the consumption efficiency of petroleum products in virtually all their applications. The need for improving the existing technology, creating a consumer awareness, providing financial incentives, and re-orienting policy decisions are highlighted.

Beneficiation of Non-Coking Coal for Power Plants

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A Discussion Paper Prepared by
The Tata Energy Research Institute for the
Workshop on Energy Policies, Jaipur,
December 19-20, 1986.

Table of Contents

The power sector today consumes about 50% of the total coal production of the country - which in physical terms translates to about 65 MT of coal per annum (including about 2 MT of washery middlings). The future power development programme envisages an addition of 17,000 MW in thermal power generation capacity during the VIIth plan period, 17,500 MW in VIIIth Plan and 19,500 MW during the IXth Plan. This means that by 2000 AD, the total installed thermal generation capacity will be about 72,500 MW. The coal requirements are estimated to increase from 65 MT in 1985-86 to 125 MT in 89-90, 185 MT in 94-95, and 253 MT in 1999-2000.

There are regular complaints from thermal power stations regarding the poor quality and large size of coal received by them. The presence of extraneous dirt and shale which contain abrasive matter leads to excessive wear and tear of coal mills and other coal handling equipment affecting their availability and life. This results in increased cost of operation and maintenance, and in a substantial decrease in the overall utilisation of installed capacity. Further, the ash content (or UHV) of coal supplied in different consignments from the same/multiple coal sources varies widely, and according to power stations, the fluctuations are upto 20 - 25%. It is felt that with such wide variations, steady conditions of operation of power plants is not feasible.

CEA has carried out a study to assess the loss of operating hours per annum in thermal power stations due to forced full and partial outages attributable to coal quality. The study reviewed the performances of 200/210 MW units (39 units in 83-84 and 49 units in 84-85) and revealed that the total forced outage loss during 83-84 was 28.9% (587 hours) and during 1984-85 was 27.08% (492 hours). Details are given in Appendix I. However, this data needs to be examined with care as neither the collieries maintain reliable data regarding coal quality supplied nor are the power stations able to provide quantified information on the effect of coal quality on plant performance. Moreover, a number of factors other than coal quality affect the plant performance. It may be of interest to note that among the NTPC - run units viz. Singrauli, Ramagundam and Korba super thermal power stations it is reported that the the PLF at Korba (which uses coal with ash content upto 40%) is the highest. By comparison, the Singrauli unit uses coal from Jayant colliery having an average ash content of 25-30% and Ramgundam unit uses coal with average ash content ranging upto 35%.

The two basic reasons for the poor quality and the variation in the quality of supplied coal are:

- The mixing of non-coal material with coal due to heavy mechanisation in opencast mines.
- Despatch of coal from different coal sources to a single power plant resulting in variation in quality.

For better operation, the power stations indicate that they want consistency of coal size (less than 200 mm) and quality (ash between 35% to 40%). In the new power plants, the boilers are designed to accept coals with gross calorific values of 4000/3500 kcal/kg which corresponds to 'F' grade coal.

Need for Beneficiation: Beneficiation of low grade coal (F and G) is essentially to remove extraneous abrasive material from coal thereby making the coal better suited for handling and crushing, as well as to reduce wear in the system. The process also causes the maintaining of a coal supply of consistent quality.

No tangible efforts have been made so far regarding beneficiation of power grade coals. Detailed studies made by CIL, CEA, BHEL and others have brought out several advantages of beneficiation of non-coking coal for power stations. This would lead to reduction in quantity of coal consumed for a given level of power generation and consequent savings in transportation and handling, reduced wear and tear in equipment and resultant savings in cost, and above all increased generation.

The cost of beneficiation has a direct relationship with cost of power generation, reliability of operation of the plant, congestion of rail traffic etc. Apart from monetary benefits likely to accrue,

additional points of interest are:

i) reduction in fuel oil consumption as support fuel due to less frequent start-ups and shut down, and better flame stability factor;

ii) savings in investment in wagons by railways due to reduction in transport of coal;

iii) provision of much less reserve/standby capacity due to minimised risk of power interruptions etc.

Washability investigations

CMPDI had investigated a large number of mine sites for washability characteristics and a few project reports on the subject have also been prepared. In general, raw coals tested were of 'F' and 'G' grade. The yield of clean coal varied from 73.2 to 81% depending upon washability test, and rejects varied between 19 to 26.8% with ash contents of 62.9 to 75.2%. The prepared coal quality improved to 35% ash as compared to raw coal ash of 40-45%.

Figure 1 shows the results of these tests. It is observed that the relationship between the yield of washed coal and the ash content in the yield is linear thereby implying that a planned decrease in the ash content would result in a proportional decrease in the total yield. These limited investigations show that a 1% decrease in the ash content would decrease the total

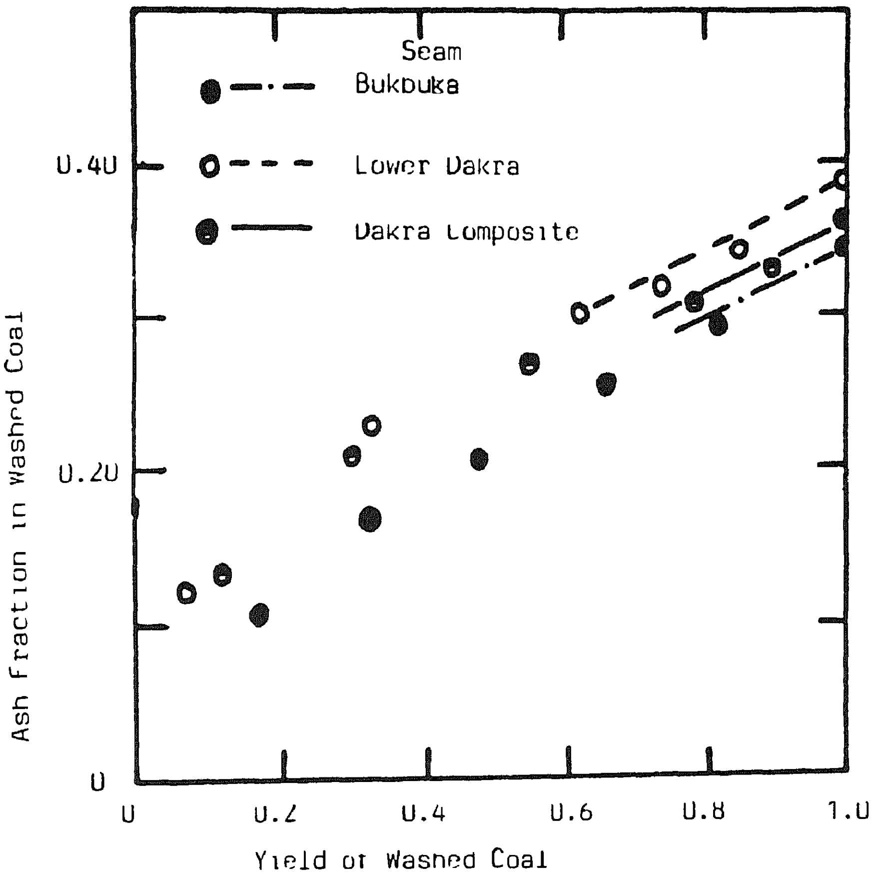


Figure 1. Washability of Indian Coals

yield of washed coal by 4.4%.

Technology of Preparation

The technologies adopted are quite simple. Uses of Baum jig, modern jig or other processes for the lump beneficiation of coal are the principle processes. Recently M/s Humboldt Wedag, India have developed ROMJIG for beneficiation of low grade Indian coals. It is a simple process and they have claimed very low investment cost and preparation cost.

Piprawar Coal Production Plant :

From a perusal of the Piprawar CPP feasibility report, the following points emerge:

1. This is a 5 mt/annum beneficiation plant linked to Piprawar opencast mine (5 mt/annum). The mine is linked, to a National Capital region thermal power station of M/s NTPC located at a distance of about 1200 km from the mine. The raw coal to be prepared has an average ash content of 40% with a UHV of 2414 kcal/kg (Gr.F). The prepared coal will have an average ash content of 33% (at an yield of 78%) with a UHV of 3242 kcal/kg. The estimated capital investment is Rs.31.23 crores, and the cost of prepared coal is Rs. 177.08 per tonne at 85% capacity utilisation and 14% return on investment. The ROM price per tonne of F grade raw coal is Rs. 113.50 and this increases to Rs. 177.08 after

beneficiation.

Since future power stations are in any case being designed to use coal with gross calorific value of 4000/3500 kcal/kg (F grade coal), it is not clear as to why NTPC has indicated prepared coal with 33 ± 2% ash with a UHV of 3240 kcal/kg. If prepared coal with 35-38% ash is supplied, this may bring down the cost of beneficiated coal. Further, the total moisture content in beneficiated coal on as received basis 'has been a major point of dispute between NTPC and CIL during discussions.

As per a study conducted by National Productivity Council (for N.T.P.C.), beneficiation of high moisture coals like Piprawar project will not result in increase in total moisture content. Because of intensive mechanical drainage system in the beneficiation plants, the moisture content in beneficiated coal will not exceed 5% over and above the equilibrated moisture content. Air drying in the colliery before despatch can further reduce the total moisture content in coal which will lead to saving in rail transportation cost, improve the boiler efficiency and also the pulveriser performance.

Economics of beneficiation

Beneficiation of coal has both cost and benefit aspects. Beneficiation will increase the cost of coal

depending upon the washability characteristics of coal and the process. On the other hand, by beneficiation, power houses can get consistent quality and size of coal which will improve the performance of the boilers, will reduce capital, operating and maintenance costs, will provide substantial coal transportation savings for the power station and will increase the PLF. The benefits will have to balance the additional cost if coal beneficiation for power stations is to be economically justified. The cost of beneficiated coal consists of two parts:

a) process cost of beneficiation;

b) cost due to rejects.

With more percentage of rejects, the cost of beneficiation/tonne of output will be more.

A techno-economic study was carried out by a group consisting of representatives of CEA, CIL, BHEL and Ministry of Energy in 1978. This was updated with figures of December 1985. This report has observed that:

- Coal beneficiation for new power stations, located at pithead is justified if the PLF improves by 539 hrs. per annum. For existing stations, the figure is 571 hours per annum for a 200 MW plant.
- For distant power station with a PLF improvement of 5% (267 hrs) the coal beneficiation is justified for new power stations located beyond

1025 km from coal source and for existing power stations located at more than 1175 km.

Cost of Transportation: The amount of coal required per unit of energy generation decreases with increase in heat content of coal. The difference in cost of transportation is due to the difference in quality of coal required for the same energy output and is a function of distance only.

A preliminary study has been carried out by TERI to investigate the effect of coal quality (ash content) and transportation distance on these costs for a 200 MW plant. Details of this study are given in Appendix II. It is found that the washed coal cost increases with decrease in ash content, while the tranportation cost (for a particular distance) decreases with decrease in ash content. It is found that an optimum ash content exists for each distance which minimizes the total cost of coal (to the power plant). This optimum ash content has been computed for various distances and is shown in figure 2. The additional cost of providing washed coal of the optimum ash content is also shown in figure 2. This addditional cost includes the cost of washing the present coal requirement as well as the cost of the additional washed coal requirement due to the increase in plant operation. This increase is assumed to be 500 hours/annum, and the additional revenue accruing due to

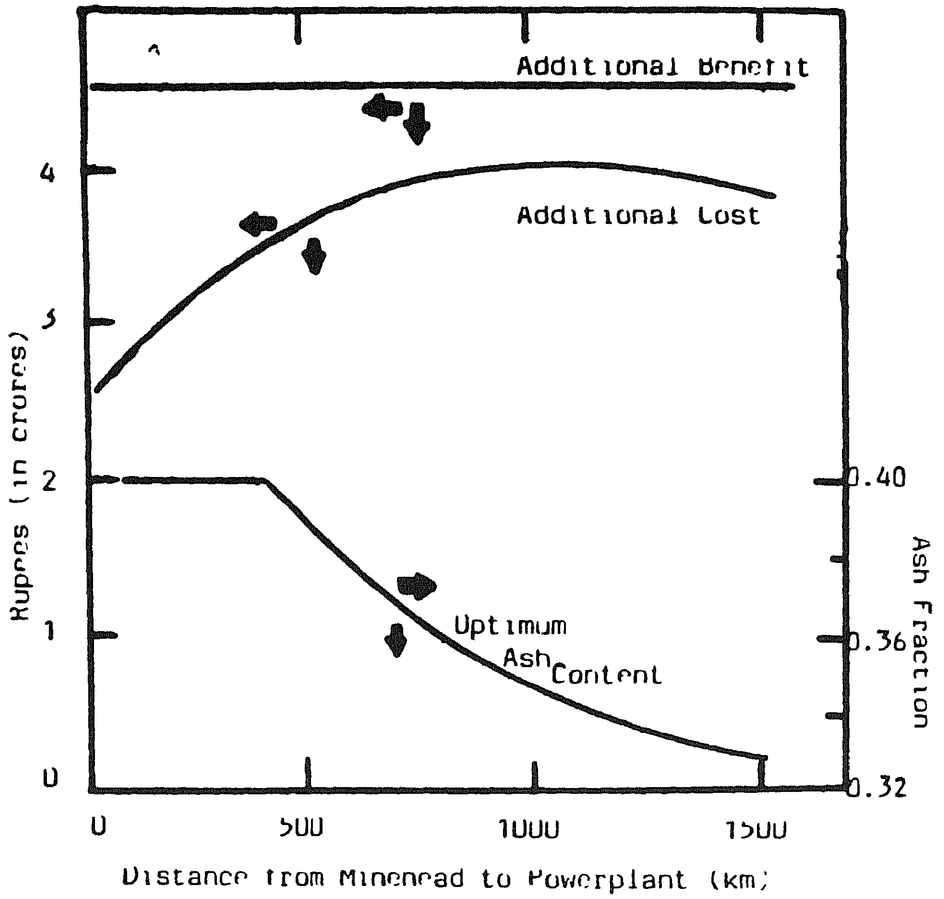


Fig.2. Optimum Washery Operation.

Table I Cost - Benefit Costs & Figures Used in Calculations

1.	Coal-Equivalent of Electricity	:	0.6 kg ROM Coal/ Kwh
2.	Average Hours of Operation per Year on ROM Coal, H_R	:	5350 hours
3.	Additional Hours of Operation per year due to washed coal, H_a	:	500 hours
4.	Cost of ROM coal (F-grade), C_R	:	Rs. 111.5/T
5.	Cost of washing, C_w	:	Rs. 19.21/T of ROM coal
6.	Cost of freight, C_f	:	Rs. 0.25/T/km
7.	Ash content in ROM coal, f_{aR}	:	40%
8.	Moisture content in ROM coal, f_{mR}	:	7%
9.	Moisture content in washed coal, f_{mw}	:	8%
10.	Washability Curve a	:	-0.76
	b	:	4.4
11.	Selling price of electricity, E	:	Rs. 0.45/kwh

the sale of electricity generated during these additional hours of operation is also shown in figure 2. Costs and other data used in these computations are listed in Table 1.

Figure 2 shows that it is economical to wash coal even at the minehead, though without reducing the ash content. In these cases (for distances less than 400 kms), the washing ensures removal of shale and other extraneous matter that could strain the coal handling facility at the power plant. For plants more than 400 kms away, washing coal to obtain a yield of a desired ash content (less than that of the ROM coal) is beneficial since the loss due to rejects is compensated by lower transportation costs.

Rejects Utilization

The rejects of the washing process present two problems : in the first case, they represent a zero-value by-product, and secondly, they pose a disposal problem in as much as spontaneous combustion occurs if the rejects are not compacted. Their low calorific value precludes their use as fuel in conventional boilers, but however they can potentially be burnt in a fludized-bed boiler which is part of a captive power plant. Fluidized-bed boilers have the capability of utilizing a vast range of feed fuels with heating values as low as 1600 k cal/kg. This is because the overall solids circulation pattern in a fluidized-bed ensures

good contact between the combustible matter and the combustion air, thus maintaining continuous combustion even with feeds having low combustible matter content.

BHEL has successfully demonstrated the fluidized-bed combustion of rejects for a coking coal washery, but no study has been carried out on the potential of the fluidized-bed combustion of non-coking coal washery rejects. It is difficult to even provide a technical evaluation of this concept as the calorific value of non-coking coal washery rejects is not reported anywhere. A materials balance around the washery unit based on the ROM and washed coal compositions has been carried out to find the composition of the rejects, and their gross calorific value has been calculated based on this composition. Details of this material balance are given in Appendix III. Figure 3 shows the calculated GCV of the rejects as a function of the ash content in the washed coal. It is seen that the GCV of rejects increases with decrease in the washed coal ash content, and is only 2196 k cal/kg when the washed coal ash content is 39% (which is the optimum ash content for a plant situated 500 kms from the minehead). These calculated GCV values are quite close to the minimum HHV of fuel required for a fluidized-bed combustor, and considering the approximate nature of the analysis in Appendix III, it is difficult to say whether the fluidized-bed combustion of non-coking coal washing

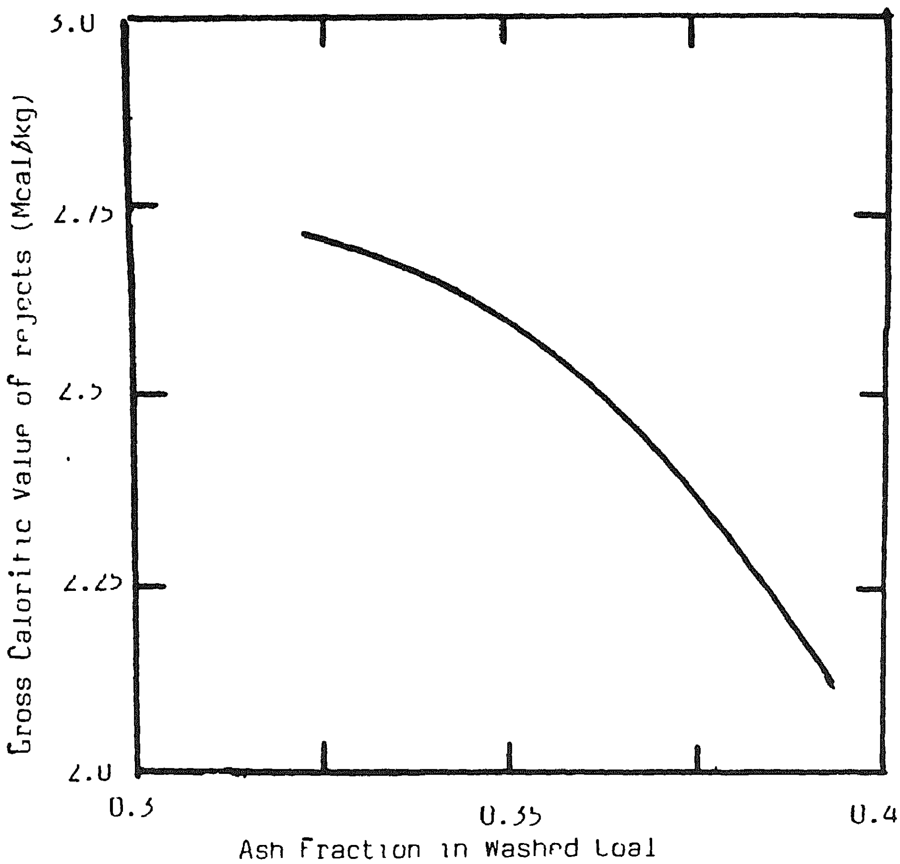


Fig. 3. Gross Calorific Value of Washery Rejects.

rejects is technically possible. Scientific data regarding the composition and GCV of rejects is required before an unambiguous answer is made.

The capital and operating costs of fluidized-bed boiler based power plants are the same as those of conventional boiler based power plants. However, the largest fludized-bed power plant presently being installed anywhere in the world has a capacity of only 160 MW (by the TVA), and consequently the economies of scale provided by large generating units are not yet available with fluidized-bed systems. In India, BHEL is presently installing only 30 MW systems, but plans to fabricate 60 MW systems. Consequently, the cost of power generated by these plants will be more expensive than that provided by the grid. BHEL estimates the cost of electricity from a 7.5 MW coking coal washery rejects burning fluidized-bed system to be about Rs. 0.94. The availbility of electricity, however, from these captive power plants will, to some extent, compensate for the perpetual scarcity of power from the grid, and therefore allow an increase in the annual mine production. The revenue due to this extra production can be at least indirectly attributed to the investment in the fludized-bed power plant. The total shortfall in the power supply to the coal industry in the eastern region is about 25%, and it is clear that the fluidized-bed combustion of rejects can alleviate this problem to some

extent.

Conclusions

1. Based on the present cost of beneficiated power coal (report of CMPDI), the present study shows that coal beneficiation is economically viable. Therefore, a policy decision may be taken for beneficiating coal for new TPS. It should be emphasized that extensive washability tests and proximate analyses of coal are required in order to provide a firm quantitative basis to the study.

2. A pricing policy may be evolved according to which the rejects should be charged on the basis of its combustible content rather than on weight basis. This is justified because when viewed from a national perspective, the non-coaly material associated with the coal has to be disposed of either at the pit head or at the washery or after combustion in the boiler plant at the power house. Hence, the overall loss which the coal companies/nation would actually suffer by way of rejects is the loss of combustibles in the rejects and not the total quantum of rejects itself.

It is suggested that an overall heat balance should be worked out showing the energy loss in rejects vis-a-vis reduced energy consumption/loss in coal transportation, boiler auxiliaries, boiler losses etc.

3. The ROMJIG technology suggested by M/s Humboldt Wedag - India, may be tried on experimental basis in a few mines to work out the economics. If the cost of investment and operation is as low as indicated by the firm, then the beneficiated coal can be charged on the graded price based on UHV.

4. The Government's policy of establishing pit head TPS has been implemented to a large extent. Therefore, a policy decision may have to be taken regarding location of new power plants - may be midway between sources of coal and consumers. A suitable model can be worked out based on beneficiated coal/raw coal costs.

5. Beneficiated coal for power sector will result in savings in coal transportation for a given generation. This will result in reduced investments by railways for coal movement. As per a CEA report, an approximate estimate of the reduction in wagon requirement for a 1000 MW power station located 1000 kms from the coal source is 288 wagons. This will lead to considerable saving in new investment by railways for coal movement to distant power houses.

6. Use of rejects for FBC for power generation has to be investigated for its viability.

7. For better operation of large units, of 500 MW capacity (sixteen will be in operation by 1994-95) it is desirable to supply consistent quality and size of coal

which will require beneficiation.

8. A single agency should examine the subject in totality and lay down policy guidelines. This may be done by the Advisory Board on Energy, since many agencies like Dept.of Coal, Power, CIL, NTPC, SEBs, Railways and Planning Commission are involved and each agency examines the issue only from its point of view and economies.

Appendix I.

Loss of operating hours in thermal power station due to forced full outage attributable to coal quality.

Forced Outages

	No. of outages		No. of outage per unit involved		Gwh loss/ outage		No. of hours lost per unit		Loss of hours attributable to poor coal quality.	
	83-84	84-85	83-84	84-85	83-84	84-85	83-84	84-85	83-84	84-85
Boiler Tube Leakage.										
Economiser	16	32	1.1	1.5	40.73	24.28	213	174	106	87
Superheater	8	34	1	1.5	20.56	30.88	98	220	49	110
ID fan	16	26	1.3	2.1	8.8	10.7	54	187	27	53
Milling System	30	27	1.4	1.5	11.4	11.1	76	79	38	39
Coal feeding	14	34	1.4	2.3	68.8	23.2	459	254	367	203
							Sub-total 'A' :		587	492

APPENDIX II

Costs and Benefit of Coal Beneficiation for a 200 MW Plant

Cost of washed coal, Rs./T $= \frac{C_R + C_W}{w}$

Freight cost, Rs./T $= C_F d$

Amount of ROM coal needed for H_R hours of operation/annum, T = 120 H_R (based on 0.6 kg ROM requirement for 1kwh generation)

Amount of ROM coal needed for H_w hours of operation/annum, T = 120 H_w

Energy equivalent requirement of washed coal per annum, T (for H_w hours of operation) = 120 H_w (G_R/G_w)

Hence, annual cost of washed coal (for H_w hours of operation), Rs. = $(120\ H_w\ G_R/G_w)\ [(C_R+C_w)/w + C_F d]$

& Annual cost of ROM coal (for H_R hours of operation), Rs. = $120 H_R\ (C_R + C_F d)$

Therefore Additional cost per annum due to washed coal, Rs. = $C_A = 120\ (H_w\ G_R/G_w)\ (C_R+C_w)/w + C_F d) - 120\ H_R\ (C_R + C_F d)$

From Figure 1, $w = a + bf_{aw}$ for $0.3<f_{aw}<0.4$

also

$G = 10^6\ [8.56\ (1-1.1\ f_a) - 14.56\ f_m]$

Hence, $G_R = 10^6\ [8.56(1-1.1\ f_{aR}) - 14.56\ f_{mr}]$

$G_w = 10^6\ [8.56(1-1.1\ f_{aw}) - 14.56\ f_{mw}]$

Hence, w and G_w are dependent of f_{aw}. In order to find the optimum value of f_{aw}, f^*_{aw}, at which C_A is minimized (for a constant d),

$dC_A/df_{aw} = 0$

Substituting the expressions for w, G_R and G_W in the expression for C_A, differentiating with respect to f_{aw}, and equating the differential to zero yields the following expression for f_{aw}* :

$$f_{aw}^* = \left[(C_R + C_w + 1)^2/(2 C_F d\, b)^2 + (a/b)^2 + \{(a/b) + (a/b)^2 - 1546 f_{aw} + 0.91\}/(C_F d\, b)\right]^{1/2} - \{(C_R + C_w + 1)/(2 C_F d\, b)\} - (a/b)$$

Substituting f_{aw}* in W & G_W, and then calculating C_A gives the value of minimum additional cost, C_A*, for the particular distance d.

The additional benefit due to the H_a hours of additional operation per annum, Rs = $2 \times 10^5\ EH_a$

APPENDIX III

Energy Content of Washery Rejects

Proximate analysis and calorimetric tests of the rejects are the best and most unambigous methods for determining the energy content of the rejects. Neither are reported in literature, and consequently a very elementary analysis is carried out in the following in an attempt to obtain, at least, approximate values. The energy content is obtained from the expression relating the gross calorific value (GCV) to the ash and moisture content. These two contents are calculated using materials balance in a washery.

1. Materials balance in a washery

Basis : 1 T of wet ROM coal

Composition of wet ROM coal : Ash Fraction = 0.4
Moisture Fraction = 0.09
Volatiles Fraction= 0.23
Carbon Fraction = 0.28

<u>Washed Coal</u>

Yield of washed coal, $w = 4.4 f_{aw} - 0.76$ (from figure 1)

Composition of washed coal : Ash fraction, f_{aw}
Moisture fraction, $f_{mw} = 0.08$

<u>Rejects (Sinks)</u>

Yield of sinks, $s = 1-w = 1.76 - 4.4 f_{aw}$

Amount of ash, $A_s = (1)\ (0.4)-(f_{aw})(4.4 f_{aw}-0.76)$

$= 0.4 + 0.76 f_{aw} - 4.4 f_{aw}^2$

Amount of moisture, $M_s = (0.09)-(0.08)\ (4.4 f_{aw}-0.76)$

$= 0.1508 - 0.352 f_{aw}$

Therefore Ash fraction in sinks, $f_{as} = A_s/s = (0.4 f_{aw}w)/(1-w)$

And moisture fraction in sinks, $f_{ms} = M_s/s =$ (0.1508-0.352 $f_{aw}/(1-w)$

2. <u>Energy Content of Rejects</u>

The energy content is calculated from :

$G_s = 10^6$ [8.56 (1-1.1 f_{as}) - 14.56 f_{ms}]

Since f_{as} and f_{ms} depend on f_{aw}, the value of G_s has been calculated for various values of f_{aw}, and is plotted in figure 3.

Implicit assumptions in this analysis are :

1. The moisture take up by coal is 2%, and is uniformly distributed in floats and sinks.
2. The yield-ash content relationship is linear, and
3. The gross calorific value is given by the expressioon used, and is representative of the high heating value.

Nomenclature

a	Intercept in yield-ash content linear regression, -
A_s	Amount of ash in sinks, T
b	Slope in yield-ash content linear regression, -
C_A	Annual cost of coal, Rs.
C_A^*	Minimum value of C_A for a particular plant - minehead distance, Rs.
C_F	freight cost, Rs/T/km
C_R	Cost of ROM Coal, Rs./T
C_w	Cost of coal washing, Rs./T of ROM coal
d	Powerplant - minhead distance, km
E	Selling price of electricity, Rs./kwh
f_{aR}	Fraction of ash in ROM coal -
f_{as}	Fraction of ash in sinks (rejects), -
f_{aw}	Fraction of ash in washed coal, -
f_{aw}^*	Value of f_{aw} at which C_A^* occurs, -
f_{mr}	Fraction of moisture in ROM coal, -
f_{ms}	Fraction of moisture in sinks (rejects), -
f_{mw}	Fraction of moisture in washed coal -
G_w	Gross calorific value of washed coal, kcal/T
G_R	Gross calorific value of ROM coal, kcal/T
G_s	Gross calorific value of sinks (rejects), kcal/T
H_a	No. of additional annual hours of power plant operation due to washed coal utilization, hours/year
H_w	No. of annual hours of power plant operation using washed coal, hours/year
H_R	No. of annual hours of power plant operation using ROM coal, hours/year
M_s	Amount of moisture in sinks, T

s Yield of rejects (sinks) -

w Yield of washed coal (floats), -

Energy Conservation In Japan

1986.12.20
T.NIIKURA
The Energy Conservation Center, Japan

1. Energy Situation in Japan

1.1 Structure of Energy Supply in Japan (Chart 1)

1.2 Energy Utilization in Japan (Chart 2,3)

2. Development in Energy Conservation

2.1 Vulnerability of Energy Supply

- Goal of Energy Policy of Japan

i) Securing a stable oil supply

ii) Promoting the development and introduction of alternative energy source such as nuclear power, coal and natural gas

iii) Promoting energy conservation

2.2 Purpose of Energy Conservation

2.3 Development in Energy Conservation

2.3.1 The Economy as a whole (Table 1)

2.3.2 The Industrial Sector (Table 2)

2.3.3 The Residential/Commercial Sector (Chart 4)

2.3.4 The Transportation Sector (Chart 5)

3. Energy Conservation Policy

3.1 Organization

3.2 Categories of Energy Conservation Policy Measures

3.3 Measures Pertaining to the Energy Conservation Law

- "The Law Concerning the Rationalization of Energy Use" (Energy Conservation Law) enacted in 1979

3.3.1 Measures pertaining to Factories

- Standard for the rationalization of energy use in factories (1979)
- Designated Energy Management Factory

  Fuel -- 3000 kl or more/year

  Electricity -- 12 GWh or more/year
- Energy Managers

3.3.2 Measures Pertaining to Buildings

- Standard for the rationalization of energy use in buildings (1980 and 1985)
- Guidelines on the design and construction of residential homes (1980)

3.3.3 Specific Appliances

- Air conditioner (1978 → 1984, 17%)
- Passenger Car (1978 → 1985, 12%)
- Refrigerator (1978 → 1983, 20%)

3.4 Measures providing Incentives to Energy Conservation

3.4.1 Financial Incentives

< Tax >

- Energy Base Advancement Investment Promotion Taxation System

  - special depreciation (30% of investment cost)

  or

  - reduction of corporate tax (7% of investment cost)

< Loan >

- Japan Development Bank
- Small and Medium Enterprise Finance Corporation
- Natioal Finance Corporation

3.4.2 Commendation System

3.4.3 Energy Audits for Small and Medium Sized Companies

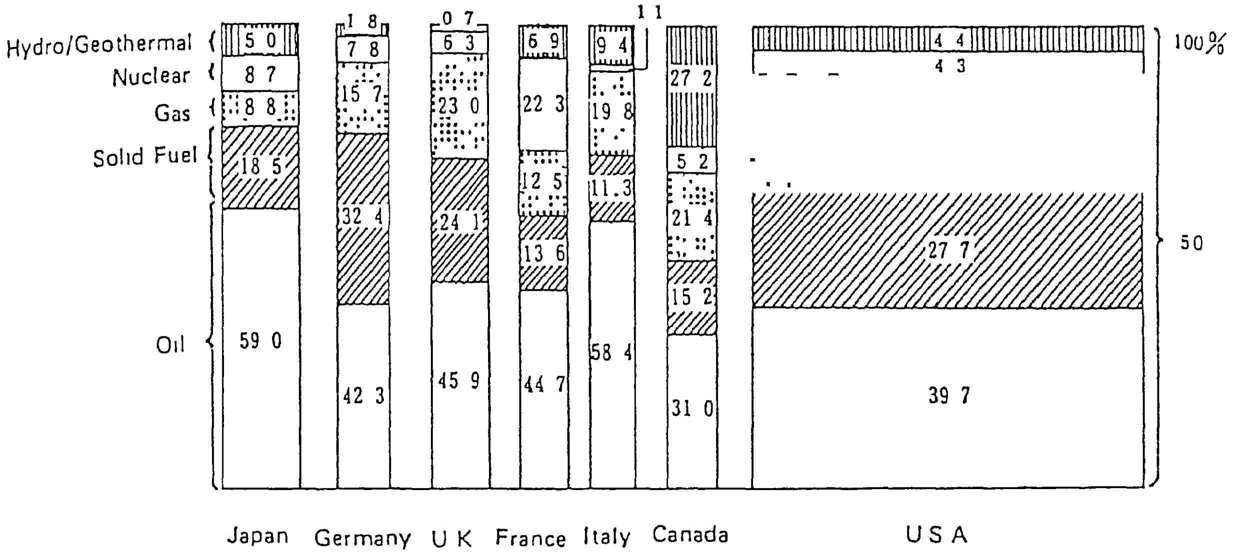
3.5 Research and Development (Table 3)

3.6 Publicity (Table 4)

CHART 1

Primary Energy Supply Patterns (1984)

(unit' %)

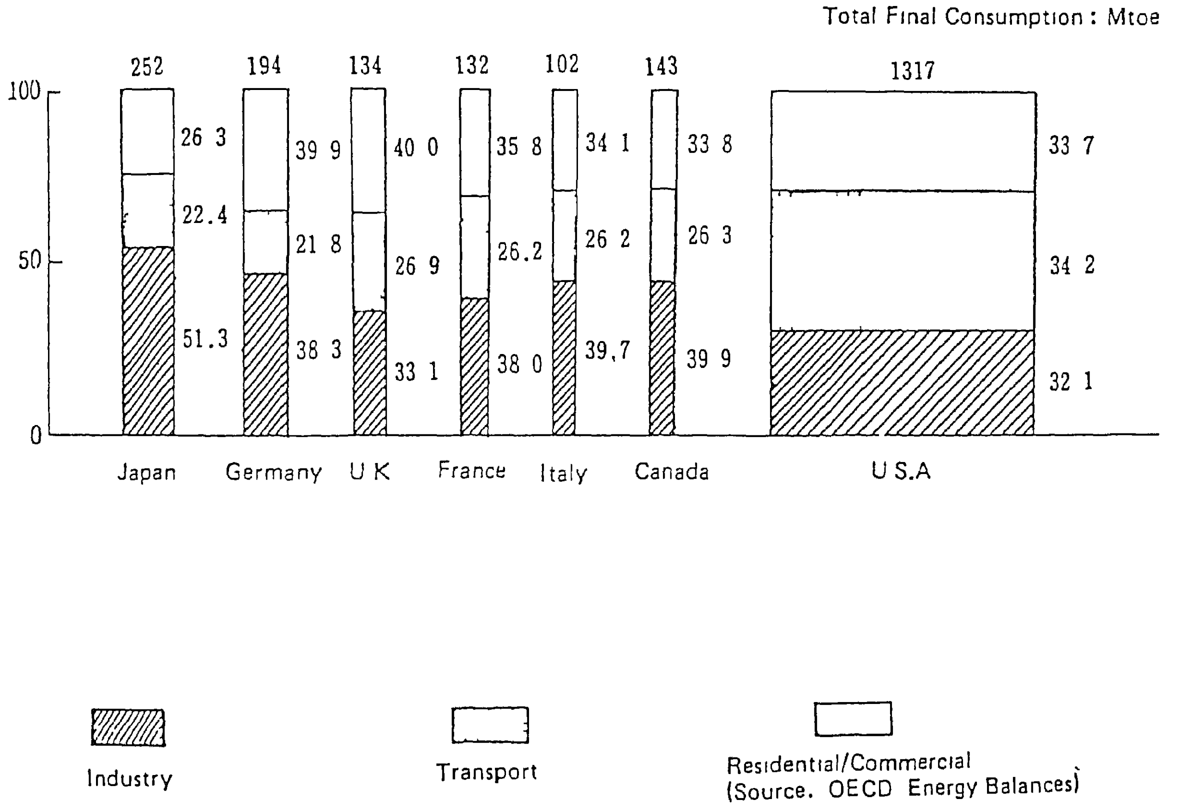


	Japan	Germany	U K	France	Italy	Canada	U S A
Total Primary Energy (Mtoe)	377	263	192	191	136	224	1800
Dependence on Imported Energy (%)	82 8	51 1	−6 5	58 9	79 6	−18 3	9 6
Dependence on Imported Oil (%)	99 8	95.1	−46 7	96.7	97 1	−20 3	30 4

(Source OECD Energy Balances)

CHART 2

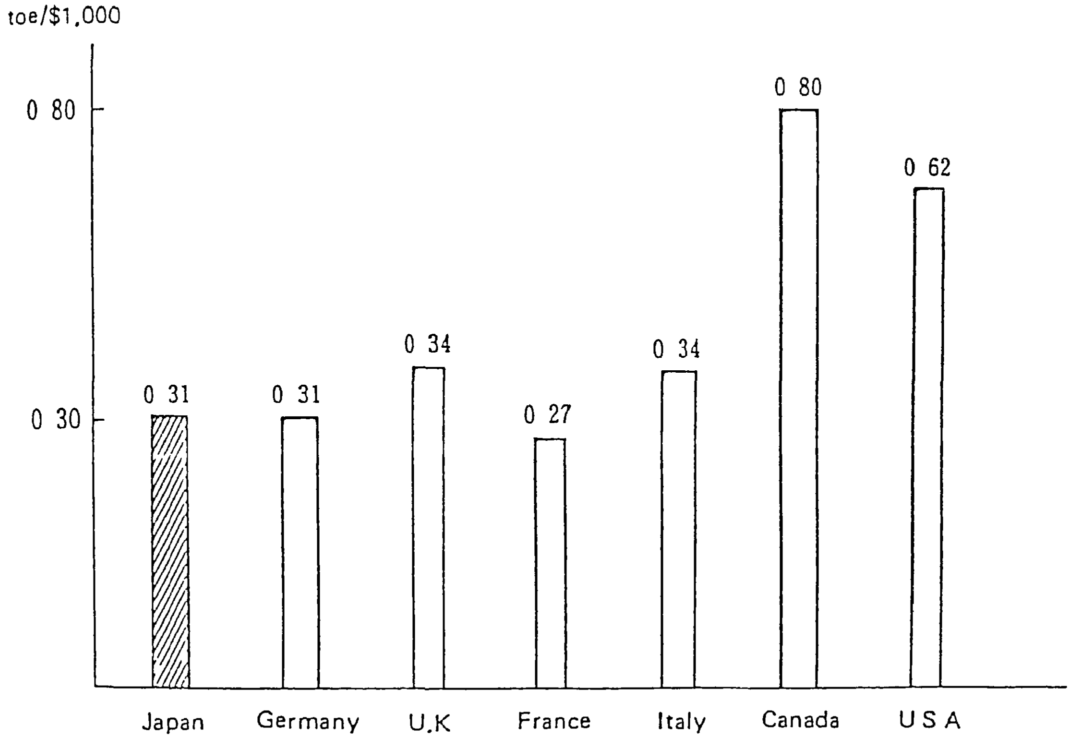
Energy Consumption Patterns (1984)



(Source. OECD Energy Balances)

CHART 3

Total Primary Energy Requirements per GDP (1984)



(Source OECD Energy Balances)

TABLE 1

Japan's Energy Demand

Fiscal Year	1973	1979	1983	1984	1985
Energy Demand (mil. klCOE)	407	443	414	436	439
ED/GNP (kl/bil yen at 1980 value)	22.1	19.0	15.5	15.5	15.0

TABLE 2

ENERGY CONSERVATION MEASURES IN ENERGY INTENSIVE INDUSTRIES

(unit. %)

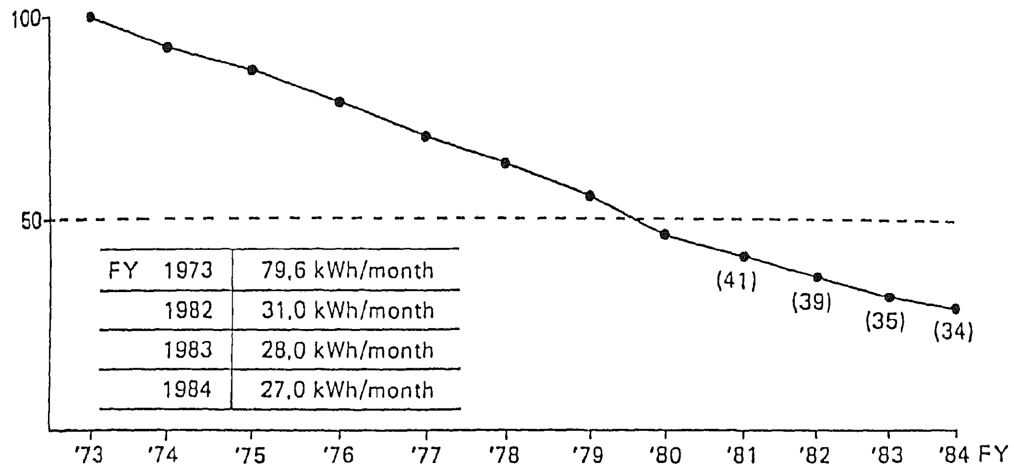
Industry	Indices of reduction of energy consumption rate (1985/1973)	Outline of energy conservation measures	Representative energy conservation equipments, etc.	Spread rate (%) (as of Mar. 31, 1986)
Iron & steel	78.8 (24 4)	(1) Improvement of operational technology (2) Recovery of waste energy (3) Improvement of production process (4) Raising of energy use efficiency	(1) Advanced continuous casting line (2) Blast furnace top pressure recovery turbine (3) Coke dry quenching	22 (33unit) 65 (35) 36 (27)
Aluminum smelting	100 '4	(1) Recovery of waste heat (2) Reinforced insulation (3) Tightening of combustion control (4) Improvement of electrodes	(1) Smelting furnace & holding furnace recuperator (2) Soaking pit & heating furnace recuperator	10 (10) 28 (11)
Petrochemical (Ethylene)	(1984/1973) 68.0 (78.0)	(1) Recovery of waste heat (2) Rationalization of production process (3) Reduction of reflux ratio in distillation process	(1) Equipment for heat recovery from heating furnace exhaust gas (2) Equipment for heat recovery from by-products (3) High efficiency compressors	100 (15) 100 (15) 100 (15)
Cement	72.5 (0)	(1) Application of NSP kiln (2) Improvement of raw material mills and finishing mills, etc. (3) Utilization of waste heat (4) Optimization of combustion control	(1) SP・NSP kiln (2) Vertical mill (3) Low/middle temperature waste heat recovery power generator	91 (82) 6 (42) 26 (22)
Paper, pulp	74.6 (51 9)	(1) Continuation of production process (2) Recovery of waste heat (3) Improvement in efficiency of production process (4) Recycling of paper (5) Improvement of operation control	(1) Continuous digester (2) Falling film vacuum evaporator (3) Belt press	24 (57) 40 (40) 6 (4)
Dyeing	66.9 (57.7)	(1) Establishment of maintenance control (2) Recovery and reutilization of hot waste water and waste heat (3) Introduction of energy conservation equipment such as low bath ratio dyeing machine, etc. (4) Improvement in processing conditions, etc.	(1) Heat exchanger (liquid—liquid) (2) Energy conservation type washer (3) Low bath ratio dyeing machine	20 (197) 22 (258) 28 (488)
Sheet glass	73.3 (66 4)	(1) Insulation (2) Improved sealing for furnaces (3) Improved efficiency of regenerator (4) Installation of waste heat boilers	(1) Waste heat boiler	100 (17)

Note 1. Indices are shown in percentage for FY 1973 (FY 1973 = 100).
2. Figures in parentheses show indices for oil consumption rate.
3. For aluminum smelting, the index is for reduced electric consumption rate.

IMPROVEMENT IN ENERGY EFFICIENCY OF HOME ELECTRIC APPLIANCES

(1) Refrigerators

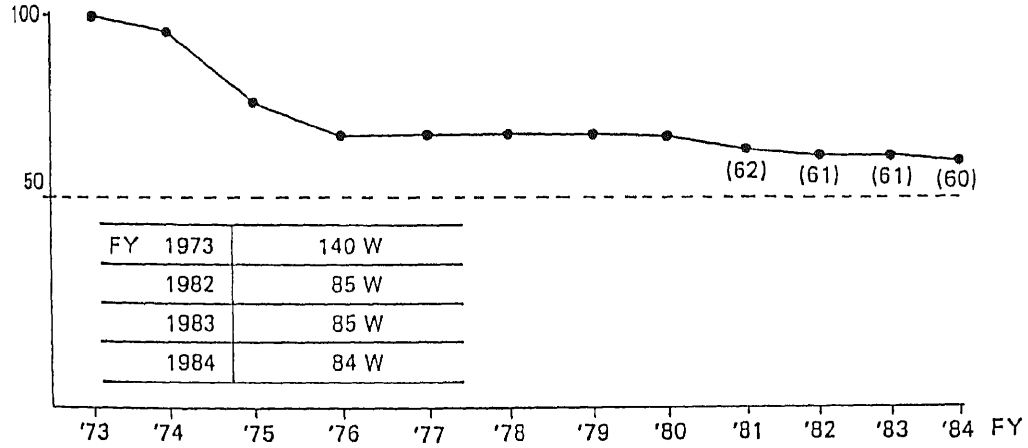
Indices of electric power consumption for one month (annual average) of the 2-door, 170-liter type
(1973 = 100)



FY	
FY 1973	79.6 kWh/month
1982	31.0 kWh/month
1983	28.0 kWh/month
1984	27.0 kWh/month

(2) Color Television sets

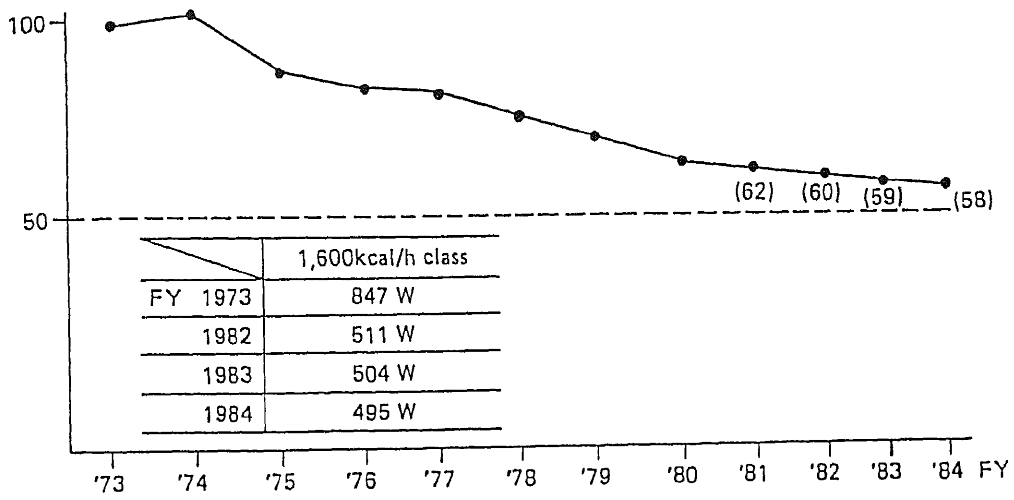
Indices of electric power consumption of the 19, 20-inch type
(1973 = 100)



FY 1973	140 W
1982	85 W
1983	85 W
1984	84 W

(3) Room Air Conditioners

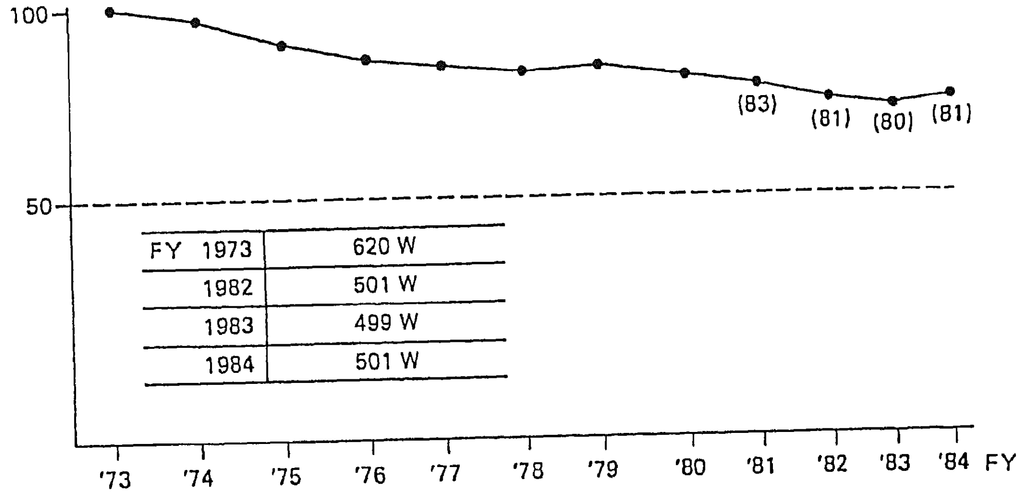
Indices of electric power consumption of the separate type
(1973 = 100)



	1,600kcal/h class
FY 1973	847 W
1982	511 W
1983	504 W
1984	495 W

(4) Vacuum cleaners

Indicies of electric power consumption (input)
(1973 = 100)



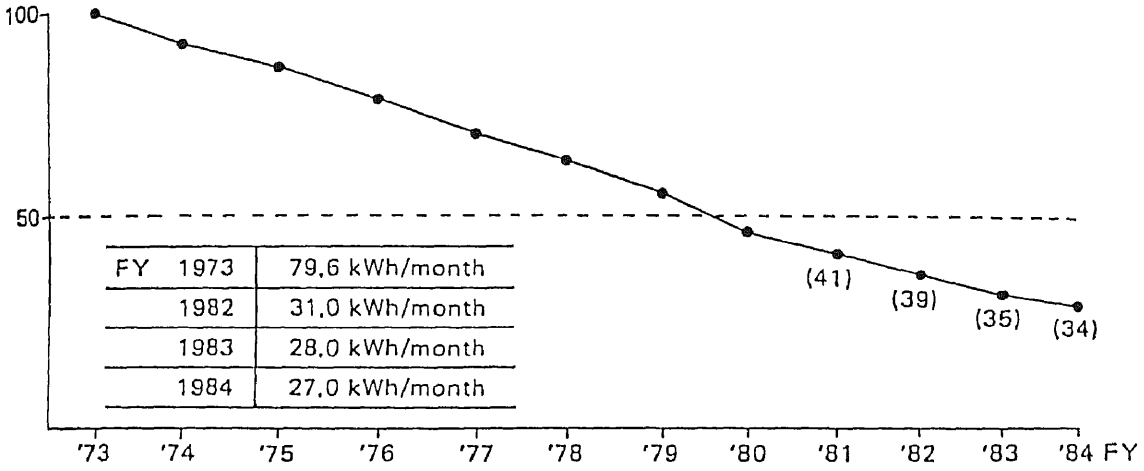
FY 1973	620 W
1982	501 W
1983	499 W
1984	501 W

CHART 4

IMPROVEMENT IN ENERGY EFFICIENCY OF HOME ELECTRIC APPLIANCES

(1) Refrigerators

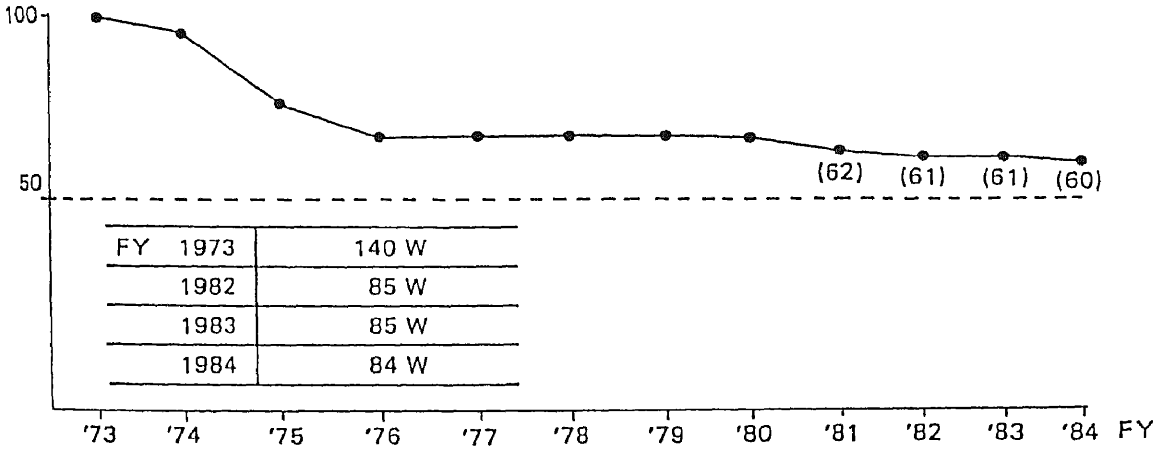
Indices of electric power consumption for one month (annual average) of the 2-door, 170-liter type
(1973 = 100)



FY 1973	79.6 kWh/month
1982	31.0 kWh/month
1983	28.0 kWh/month
1984	27.0 kWh/month

(2) Color Television sets

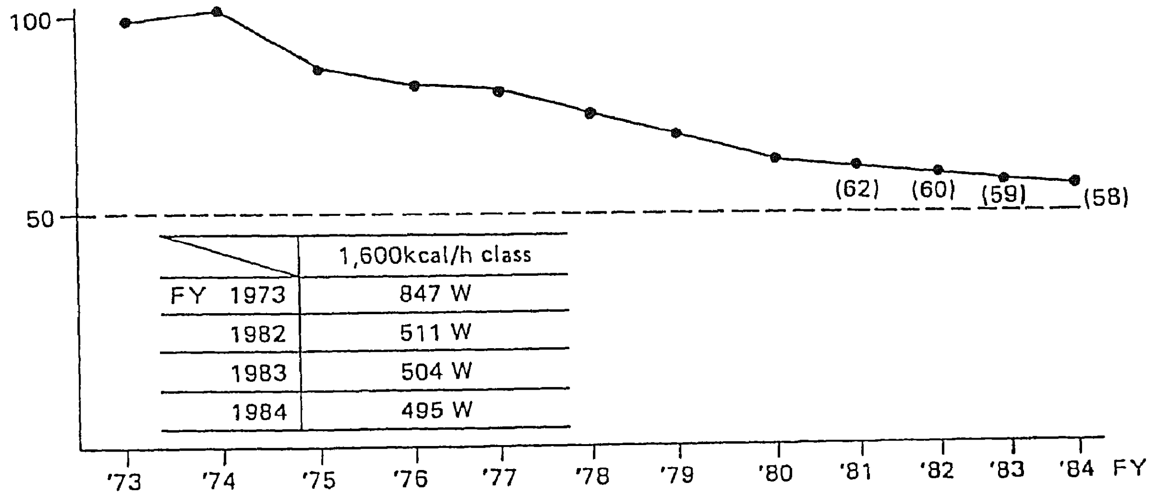
Indices of electric power consumption of the 19, 20-inch type
(1973 = 100)



FY 1973	140 W
1982	85 W
1983	85 W
1984	84 W

(3) Room Air Conditioners

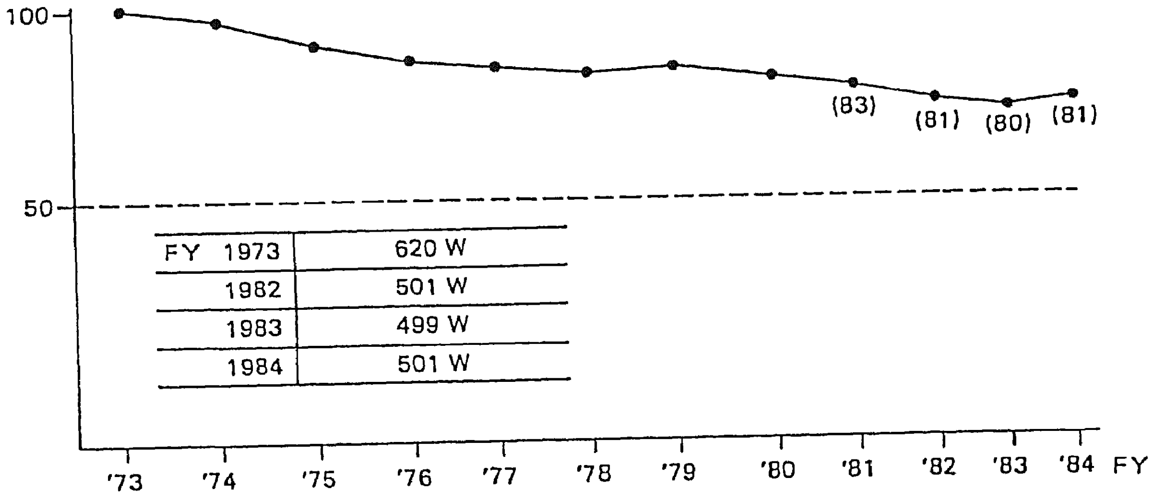
Indices of electric power consumption of the separate type
(1973 = 100)



	1,600kcal/h class
FY 1973	847 W
1982	511 W
1983	504 W
1984	495 W

(4) Vacuum cleaners

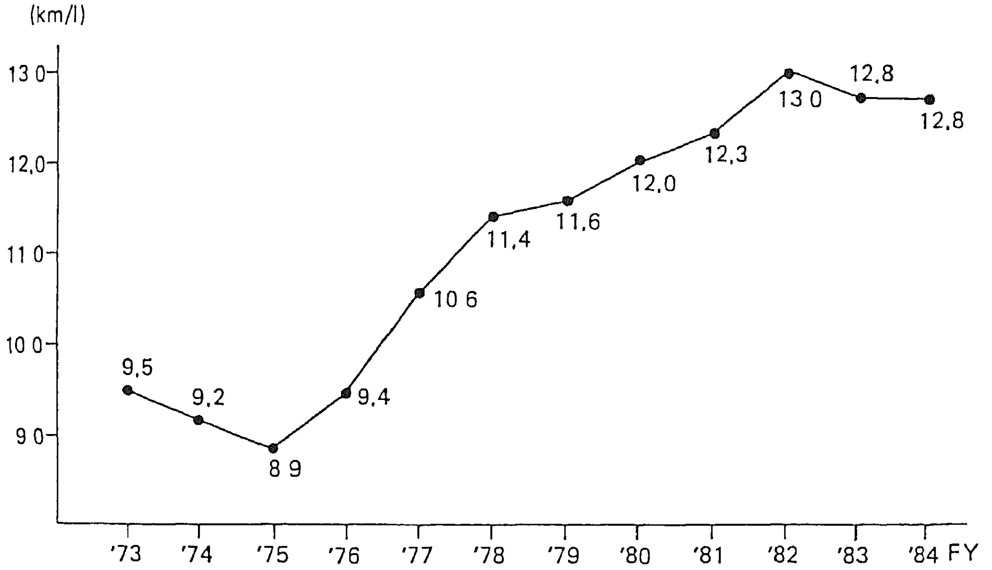
Indicies of electric power consumption (input)
(1973 = 100)



FY 1973	620 W
1982	501 W
1983	499 W
1984	501 W

CHART 5

Trends in Fuel Efficiency of Japanese Passenger Cars



Note) Average 10-mode mileage of passenger cars produced for the domestic market
Source) MITI

ENERGY CONSERVATION TECHNOLOGY R/D SYSTEMS (MOONLIGHT PROJECT)

OUTLINE OF THE MOONLIGHT PROJECT

(unit: million yen)

Item	Budget for fiscal 1985	Budget for fiscal 1986	Major points of undertakings in FY1986
Large-scale Technologies for Energy Conservation	10,464	11,815	
Advanced Gas Turbine	1,207	1,880	Trial and demonstration tests of a 100Mw-class reheat gas turbine pilot plant. Detailed designing of high-temperature high pressure part of the prototype plant as well as trial monufacturing of components
Advanced Battery Electric Power Storage System	2,201	3,170	Designing, manufacturing and the 2nd evaluation test of 10Kw class advanced batteries Testing, etc of 1Mw-class battery systems
Fuel Cell Power Generation Technology	4,776	3,190	Testing of two phosphoric acid type pilot plants (high-temperature low-pressure model and low temperature high-pressure model, each 1Mw class). Research on components of the on-site type phosphoric acid fuel cell R & D on molten carbonate fuel cell, etc
Stirring Engine for Wide Use	1,673	2 231	Trial manufacturing of engine components Trial manufacturing/testing of various kinds of practical use type engines and engine application systems Research on multifuel application
Super Heat Pump·Energy Accumulation System	607	1,345	Research on components such as compressors, heat exchangers, etc and working fluids, of super high performance compressor driven heat pump Testing of reaction cycles of chemical heat storage systems. Research on optimum equipment model as well as research on total system.
Leading and Basic Technology for Energy Conservation	227	195	In addition to the nine projects such as potassium turbine technology and coal burning MHD power generation, a newly launched project on high efficiency reheat cycle hybrid engines
International Cooperation in R & D	20	25	Participation in IEA implementing agreement on advanced heat pump systems (Annex IV, IX and two others) Promotion of bilateral collaboration, such as between Japan and France, etc
Technology Assessment on Energy Conservation 1. Technological forecasting and assessment on energy conservation 2. Feasibility study on super conducting power generating systems, etc	69	88	Investigation to establish the method of grasping overall effects of energy conservation technology by using technology relations matrices and total energy flow model. FS on components and materials concerning the superconducting power generation as well as FS on utilization of coal gas in the next generation high efficiency power generation systems
Subsidization for Energy Conservation Technology Development	140	68	Subsidization of R & D on energy conservation technology carried out by private enterprises.
Promotion of Energy Conservation through Standardization	32	23	Research and study of standardization of building materials and home/office use appliances
Others	139	57	Clerical expenses, etc necessary for R & D
Subtotal	11 091	12,271	
Subsidization for Development of Equipments for the Private Sector	55	55	New development project for heat pump for cold regions (Conditional Loans for Development of Practical Technologies Related to Oil-substitute Energy).
Total	11,146	12,326	

Activities of the Energy Conservation Center

Publicity	● Campaign for promotion of energy conservation consciousness among general public with special emphasis on the energy-consuming seasons (summer and winter), and the Energy Conservation Month (February) through posters, pamphlets and the mass media ● Holding poster and essay contests and organizing lecture sessions and symposium on energy conservation ● Energy conservation successful cases, implemented by small groups' activities in factories are invited for the contest and dissemination conventions Prizes are awarded to the excellent 50 cases by Minister of International Trade and Industry and others ● Covering all industry, transportation, and residential/commercial sectors, and with the main theme "Efficient Use of Energy" exhibitions are held in Tokyo and several other places during the Energy Conservation Month The exhibitions include panels of government's energy policy, enlightening displays by business associations, energy saving equipment for industry and household, and insulation materials for building	Factory Energy Audits	● Energy auditors who are experts of heat and electricity management technology, being assigned by ECC, make free of-charge survey on the actual state of energy consumption in small and medium-sized manufacturing factories, and on the basis of the results of the survey, guidances are given concretely and respectively
		Research	● Collection of energy conservation information ● Information service by Distribution of the information guide-book and bulletin Perusal service, copying service, and reference service ● Project research
Education	● Preparatory courses for the State Examination of Energy Management ● Seminar for energy managers of the designated energy management factories ● Correspondence course on basic energy management technology for factory foremen ● Observational study visit and lecture meeting on energy conservation technology ● Training courses for those in charge of energy management in small and medium-sized enterprises ● Training course for those engaged in consumers consultancy services within local governments	State Examination	● In accordance with the provisions of the Energy Conservation Law, and based on designation by Minister of International Trade and Industry, ECC holds the state examination and the state training course to certificate the qualified person for energy management
Publication	● "Energy Conservation" a monthly bulletin on comprehensive energy management information ● Books on energy management technology, reference books for the state examination, etc ● Reference pocketbook of energy management technology	International Cooperation	● Sending overseas study missions consisting of specialists of ECC's member companies, for the purpose of exchange of information on energy conservation ● Holding seminars and information exchange meetings on energy conservation technology in developing countries ● Sending experts teams to developing countries for the survey project on energy conservation ● Receiving study teams and trainees from abroad

DELEGATION OF THE COMMISSION
OF THE EUROPEAN COMMUNITIES
FOR SOUTH ASIA

Head of Delegation

WORKSHOP ON ENERGY POLICY ISSUES

JAIPUR - DECEMBER 1986

Remarks by M. Macioti

Boundary conditions my talk today :

- The rise of oil prices in the seventies contributed to shaping the first elements of a common energy policy for the EEC;
- The recent fall of oil prices (+ Chernobyl) has not altered the EEC long-term goals : these are adequate and secure supplies of energy at the right price;
- Between 1950 and 1973, the EEC, excluding Spain and Portugal, doubled its energy consumption to 1 billion toe (tonne oil equivalent) and forecasts for 1985 made at the time indicated that there would be further increases;
- In 1973, the Middle East crisis triggered supply problems, oil prices increased fourfold in 1973-74;
- The Community is the world's largest oil importer and consequently the energy crisis posed a major challenge;
- In 1974 the MS adopted a resolution on a Community programme on the rational use of energy, which, in the ensuing years, made it possible to develop the energy conservation policies;
- Broadly, the policy initiatives were for the more rational utilisation of energy to improve energy performance by reducing losses and gradually eliminating non-essential consumption. Such action EEC felt could contribute towards reducing growth of the Community's energy demands, without jeopardising economic and social growth objectives;
- Specifically the targets and policies were aimed to :
  a) reduce the Community's level of dependence on imported energy to 50% by 1985 (around 65% in 1973). We have achieved 42.5%

./...

./...

energy dependency in 1985 (30=oil; 6=coal; 6=gas): this is low vis-a-vis JP (80%) but high vis-à-vis US (15%);

b) reduce the rate of growth of energy consumtion for the Community as a whole (stable at 1b toe);

c) ensure by a technological research and development policy that traditional forms of energy are better exploited and in the long run replaced by new sources of energy;

between 1973 and 1985 : oil N. Sea up from 13 to 150 m toe
: nuclear up from 12 to 120 m toe.

In 1979 came the second oil shock with oil prices doubling over 1973/74 level.

In June 1980, the EC decided on energy policy objectives for 1990. These included, inter-alia commitments to:

a) reduce the share of oil in the Community's total energy consumption to about 40% (56% in 1979).

b) to increase the share of coal and nuclear energy in the fuel used for electricity generation to 70-75%.

c) to reduce the ratio between economic growth and growth in energy demand to less than 0.7 (0.94 during 1975-79).

The policy initiatives resulted in a dramatic change in the structure of the Community's energy economy.

Over the period 1973-82, Community energy demand, in particular oil, first rose in the mid-70s and then fell from 1979 by more than 12%.

This was due to the following developments:

a) improved energy efficiency (between 1973-82, EC GDP grew by 9% while energy demand fell by nearly 9.5%).

b) fourfold increase in nuclear power production.

.../...

c) increased use of coal and other solid fuels in power stations.

d) increased consumption (up over 40%) and increased net imports (10-fold increase) of natural gas.

e) the coming on stream of oil from the North Sea.

- A review of MS programmes in 1984 showed that all three energy policy objectives were likely to be achieved by 1990.

a) The nuclear/coal target has already been achieved.

b) In 1984, the total energy consumption in the Community was 2% lower than in 1973.

c) Oil consumption was down by 25% and net oil imports had been cut from 596 Mtoe in 1973 to 299 Mtoe in 1984.

- The EEC main policy lines (as spelled out by Council Nov. 1983)
  - definition of policy objectives in time (medium-term)
  - coordination MS' energy policies (prices; security stocks; common external position)
  - EEC action as complement to national activities (JET)

- Energy is a field in which lead times for many decisions and investments are very long;

- Therefore the Community has now started looking beyond the end of this decade;

- The energy objectives for 1995 as approved by Council Sept.1986 and some relevant facts from a study recently published entitled "Energy 2000" are given;

- The specific sectoral objectives are :
  1) Continued improvement of energy efficiency to achieve 20% reduction by 1995. This point particularly important : the efficient use of energy increases security of supply, improves industrial competitiveness and is beneficial to the environment;

  2) To maintain net oil imports at less than 1/3rd of total energy consumption in 1995 (EEC level of oil production in 1995 limited to 100m toe); oil share of total primary energy demand=43-46%
  net oil import dependence = 35-37%

./...

3) To maintain and if possible to increase market share of natural gas and solid fuels (nat. gas could fall to 16%; coal stable at 22%)

4) To reduce use of ore and gas in electric power stations to about 10%;

5) To ensure that about 40% of electricity output in 1995 is from nuclear energy (installed nuclear capacity by year 2,000 should be 115 GWe; utilisation rates could reach 75%);

6) To increase efforts to develop and commercialise new and renewable energies with a view to tripling their contribution to the total energy picture by the turn of the century.

- Some Specific EEC Energy Programmes :

1) A research and development programme on energy saving and alternative energy sources have been operated by the EC since 1975. This is a very ambitious programme executed either in-house (JRC) or in laboratories (industry, national, universities) of MS. It concerns fission, fusion (JET, operational since 1983/4) and non-nuclear energy (allocation of about $1.7b. between 1984 and 1987).

2) EC has been supporting demonstration projects since 1979. These are the link between R+D phase and final investment phase. It differs from the R+D phase in its industrial scale and from the investment stage in its inherent risks being still too great for entrepreneurs. They concern energy saving (building, industry, transport, energy production) alternative enrgy sources (biomass, solar, geothermal, wind, hydel), substitution for hyrocarbons and liquefaction/gasification of solid fuels. Globally, the EEC has allocated over $ 500m to the projects between 1978 and 1985.

3) For energy conservation in industry the EC in 1980 promoted the use of "energy buses" in the MA. The concept has been illustrated to Indian business and Government by Dr. Davis during his visit here in August 1986. These vans fitted with computers carry out on-the-spot energy audits and

ENERGY SAVING, ALTERNATIVE ENERGY SOURCES, ETC

European demonstration projects in the energy field

European File

Commission of the European Communities
Directorate-General for Information
Communication and Culture
Rue de la Loi 200 — B-1049 Brussels

7/86
April 1986

Between 1986 and the end of 1989, the European Community will allocate 360 million ECU [1] to assist demonstration projects concerned with energy energy saving, alternative energy sources, substituting for hydrocarbons and the liquefaction and gasification of solid fuels [2]

Demonstration projects are technological projects which represent a half-way stage between research and development on the one hand and commercial application on the other In scale they are full-size industrial operations, and they must have serious prospects of technical and economic viability However, they still entail very high risks By offering vital financial support to ambitious and carefully selected projects, the Community is helping to solve Europe's energy problems and at the same time contributing to its technological modernization

A twofold challenge, a European response

- *Strengthening Europe's independence in energy* The Community of Twelve still imports about 45% of the products required to meet its energy needs (oil, gas, coal, etc) This compares with about 70% in 1973, before the sudden rise in oil prices which was one of the factors in the international economic crisis Even though oil prices have recently collapsed, this relatively high external dependence remains a threat to security of supply and to the stability of European economies

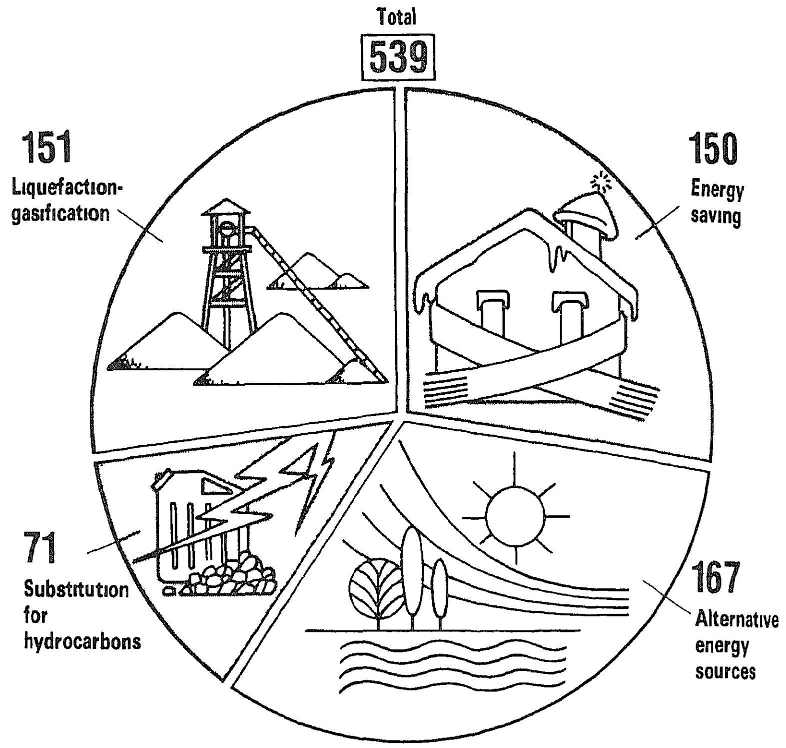
  Entrusted as it is by the European Treaties with the task of promoting a harmonious development of economic activity, continuous and balanced expansion and an increase in stability, the Community has taken up the challenge With the Member States it has undertaken a policy aimed at diversifying the sources of energy supply and at reducing external dependence It particularly encourages the rational use of energy, the development of renewable energy sources and the use of resources like coal, peat and lignite, which can be substituted for imported hydrocarbons Demonstration projects are one instrument of this policy, downstream, as it were, from the Community's research and development programmes, upstream from its aids and loans for investment in the energy sector They are an indispensable instrument because of the technical and financial risks which impede investment and thus prevent the dissemination of products or processes developed during the research and development phase

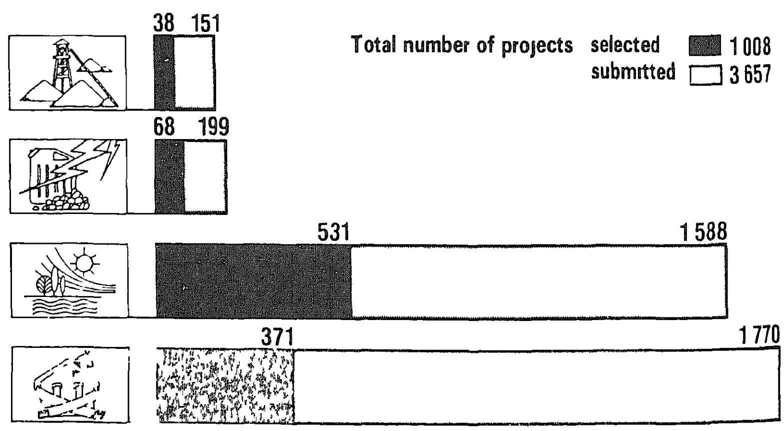
- *Promoting innovation and competitiveness* Technological modernization is imperative for competitiveness and therefore essential for employment It merits more sustained European cooperation in the face of another great challenge, an industrial one, thrown down by big outside competitors including the United States, Japan and newly industrialized countries In energy as in other sectors,

[1] 1 ECU (European currency unit) = about £0 66, Ir £0 71 or US $0 96 (at exchange rates current on 7 March 1986)
[2] This file replaces our No 1/83

European demonstration projects in the energy field, 1978-85

Aid granted by the European Community (in million ECU)





Source Commission of the European Communities, DG XVII

innovation can help Europe to create new activities and find new international markets Moreover, since its purpose is to reduce waste and increase Europe's independence with regard to energy, innovation consolidates the competitiveness of all the other sectors of the economy whose costs are influenced by energy prices Thus the Community's outline programme for scientific and technical activities attaches special importance to the energy sector and, in particular, to demonstration projects

The European demonstration projects were begun in 1978 Since then, about 3 600 proposals have been submitted to the European Commission, 1 000 of them have been accepted and have received Community aid amounting to about 540 million ECU Of nearly 120 projects now completed, about 50% have been counted as successes, 30% as partial successes and only 20% as failures Twice – in 1982 and 1985 – the European programme has been evaluated by independent experts they proposed some useful adjustments to it, but all were in favour of its continuation

The European programme in no way duplicates the programmes of individual Community countries, quite the contrary

- Initially the European programme acted as a catalyst In 1978, only two Community countries had national support for demonstration projects, by 1985, good example had had its effect and every Member State had a national programme Significant demonstration activities were developed in France, Germany, the Netherlands, the United Kingdom (for energy saving only) and, more recently, in Belgium and Italy

- At present, the Community demonstration programme supports those of Member States and acts as a useful complement to them It makes it possible to avoid duplication where different national projects are pursuing the same objective, to fill in the gaps in certain Member States' programmes, or to finance projects which, for want of funds, would not get sufficient aid at national level In addition, the results of the European programme are distributed throughout the Community, to the benefit of all Member States The programme encourages the exchange of experience among those in charge at national level, and helps ensure a wider dissemination of certain results of their programmes It is a point of reference for the rest of the world All this, as well as the scale of financing, makes it the world's leading energy demonstration programme

The projects and how they are selected

The European Commission publishes each year in the *Official Journal of the European Communities* invitations to tender regarding demonstration projects The tenders come from persons or undertakings, or from bodies involved in the promotion of technical innovation in small and medium-sized undertakings They are selected by the Commission with the aid of a committee of experts on which each Member State is represented Community aid can amount to 40% of the overall

cost of a project, if national aid is also given, total public financial support may not exceed 49% of the cost

The new Community demonstration programme, for the period 1986-89, puts even more emphasis than the preceding ones on the innovatory aspect of projects, on their technical quality, and on the stringency of their budgets Environmental problems are also taken into account Above all, the Community insists that the projects lend themselves to 'replication' and to an effective distribution of their results The aim is not to finance the one-off realization of a bright idea, but to demonstrate the feasibility and viability of a process or product, so as to open the way to industrial production and to other potential investors

Projects accepted must fulfil the following conditions [1]

- ☐ They must relate to the creation of full-size installations,
- ☐ They must exploit innovatory techniques, processes or products, or at least new applications of known techniques or products,
- ☐ They must be based on completed research and development work and must offer encouraging prospects of industrial, economic and commercial viability (An exception to this viability rule is provided for in the case of the most difficult sector, the gasification and liquefaction of coal),
- ☐ They must present difficulties with regard to finance, the technical and economic risk being such that they would probably not be carried out without public financial support,
- ☐ They must have potential for replication and must open the way for other projects of the same type In particular, they must lend themselves to commercial development and be submitted by producers, by users in partnership with producers, or by users who can guarantee replication in the event of success Those responsible for a project must also undertake, if it succeeds, to exploit it or to facilitate its exploitation and to allow the results to be disseminated For its part, the European Commission will step up its dissemination work, through conferences and publications as well as by making publicly available its specialized data bank 'Sesame'

The choice of projects also takes account of their value with regard to the protection of the environment and of their European character a certain preference can be afforded to projects involving cooperation between persons or undertakings from several Member States

For each of the principal fields covered by the European demonstration projects – energy saving, alternative energy sources, substituting for hydrocarbons, liquefaction

[1] Regulation No 3640/85 published in the *Official Journal of the European Communities*, No L 350, 27 December 1985

and gasification of solid fuels — the following is a summary of the objectives of the new programme, with an account of Community activity since 1978

Energy saving

Between 1973 and 1983, technical progress and various legislative measures and regulations made it possible to improve energy efficiency by 20% A further improvement of the order of 25% is possible by 1995 However, the necessary technology must be perfected and must be seen to be worth acquiring in profit terms The Community does a lot of work in this area, between 1978 and 1985, it has allocated about 150 million ECU to 371 projects aimed at energy saving All the economic sectors are involved building, industry, transport, as well as the production and distribution of energy itself

☐ *Buildings* The Community gives financial support to the development of processes and products for new buildings It is equally interested in simple and economic technology for existing buildings, whether for heating or air-conditioning, for insulation, for water heating, for temperature control or for recovering heat The Community programme has already scored several successes In Groningen, in the Netherlands, the Gasunie company showed that the cost of lighting offices could be reduced by 73%, by combining low-intensity central lighting with individual desk lamps In Skive, Denmark, 53 houses were built which are the most energy-sparing in the world by combining sophisticated insulation, solar collectors, heat pumps, oil-fired boilers, wood stoves and electronic temperature control, a saving of 50% was achieved compared with the Danish standard for 1977

☐ *Industry* The Community helps projects aimed at saving energy either by modifying existing manufacturing processes or by using new technology or equipment to rationalize the manufacturing process It is also interested in the recycling of residual heat and in new combinations or new uses of known technology Among the successful experiments is that carried out by the Fertimont company of San Giuseppe de Cairo (Italy), which succeeded in reducing by 40% the steam consumption required to produce synthetic urea for making fertilizer Another example in the Beghin-Say paper-mills at Corbehem (France), a heat pump working on water made it possible to use the heat from vapours produced in the manufacturing process Combining energy saving with the recycling of waste, Deborah Fluidized Combustion of Peterlee (United Kingdom) built a fluidized bed which can burn pollutant waste tar, producing vapour and leaving no inert residue Finally, in the iron and steel sector, which is a great energy consumer, the Thyssen and Usinor companies carried out projects which enabled them to recover large quantities of residual combustible gas, which up to now were released into the atmosphere

☐ *Transport* The Community concentrates its aid on profitable projects which provide significant savings and offer good prospects for repeated application

Among the projects supported was the development by Alfa Romeo of technology which reduced the petrol consumption of a fleet of Milanese taxis by 12% they were fitted with a motor which could use either two or four cylinders, depending on the power needed Other examples in France, the national railway company SNCF demonstrated that the fuel consumption of traditional trains could be reduced by streamlining them more aerodynamically, a ship equipped with the Cousteau-Malavard turbo-sail will be employed on commercial routes, using extra power obtained from wind energy

☐ *Energy production* The Community is interested in improving gas-distribution methods and methods of producing heat or electricity for collective use, in the exploitation of residual heat, in new concepts for urban and district heating and in the development of very large heat pumps Two such pumps provide some of the heating for the towns of Frederikshavn (Denmark) and Waiblingen (Germany), using as a source of heat municipal installations for treating waste water

Alternative energy sources

The share of the Community's energy needs covered by alternative sources of energy could triple between now and the year 2000, to represent 5% of overall consumption Prospects in the longer term are even more encouraging However, the development of new processes or products and the reduction of their cost require great efforts, which fully deserve help from the Community The Community's role has developed progressively, beginning with biomass, solar energy and geothermal programmes, and later including others devoted to wind and hydroelectric power A total of 531 projects were accepted between 1978 and 1985, the Community has spent 167 million ECU on them

☐ *Biomass and waste* Energy derived from waste and from plants could meet nearly 2% of the Community's needs around the year 2000, while also reducing pollution and supplying useful by-products (fertilizer, cattle feed) The Community supports various projects for using biomass and organic urban and industrial waste, and for their conversion for energy or chemical purposes Between 1978 and 1985, a total of nearly 55 million ECU was awarded in grants to 126 projects of this kind They relate especially to the production and use of biogas, but derived fuels are also involved, as well as the treatment of waste, biomass harvesting and the production of energy and heat by direct combustion or by pyrolysis and gasification The making of compost, fuels and chemical products by biological or thermochemical processes is also covered Among the most successful projects is one carried out by the intra-communal venture Intradel of Liege (Belgium), for the recycling of waste plastic Other successes were a Danish project at Viborg which extracted biogas from a dump, and two Italian projects the first, in Sardinia, is concerned with the anaerobic digestion of waste from poultry farming, producing biogas and compost, the second, carried out in Modena, involved the manufacture of a machine for harvesting vine-shoots

☐ *Solar energy* Solar energy could cover 1-2% of our requirements around the year 2000, and much more thereafter It is estimated that towards 1990 electricity from photovoltaic cells will be able to compete with power from diesel generators, for water pumping, irrigation, etc The Community supports the development of photovoltaic processes for houses, for small isolated villages, or for hydraulic equipment or other machinery It also subsidizes new thermal processes, active or passive, which use solar energy directly (without converting it into electricity) for the heating or air-conditioning of premises as well as for supplying heat for industrial purposes Between 1978 and 1985, the Community awarded 33 million ECU to assist 185 solar projects Among the successes was the Pernod factory in Lyon-Dardilly (France), where solar breeze-blocks, glass, heat pumps and a calory storage system enabled 10 000 square metres of offices and work area, as well as the water for washing, to be heated at a 50% saving on normal consumption In Inzell (Germany), a complex of open-air swimming pools was built, where the water was heated to 24 °C by solar collectors This last type of application is now sufficiently developed for the Community to stop supporting it

☐ *Geothermal energy* Heat from underground water and rocks could supply about 1% of Europe's needs by the year 2000 This potential exists throughout the Community, especially in countries like Greece, France and Italy, and has particular importance for certain regions and localities The Community is particularly interested in the exploitation of new underground strata that are not well known or are of high temperature The purpose can be to supply heat for industry or agriculture, to heat buildings or to produce electricity In all, between 1978 and 1985 48 million ECU was awarded to help carry out 92 geothermal projects Some of them involved urban heating for various buildings in Ferrara (Italy) and also in France, at Beauvais, Cergy-Pontoise and Bordeaux (Meriadeck and Pessac) Also in France, a new type of pump was developed in Meaux-Beauval, and in Lamazere eight hectares of greenhouses were heated by a geothermal system A geothermal power-station of 4 5 megawatts is already in operation in Latera, in Italy, another is due to follow in Mofete, near Naples On the islands of Milos and Nissyros (Greece), water vapour and brine are used to produce electricity For the future, the Community is putting the emphasis on the exploitation of little-known reservoirs, on the development of new techniques and technologies for underground operations and for surface equipment, as well as on solving problems of corrosion, encrustation, re-injection and clogging

☐ *Wind energy* Wind could cover up to 1% of our needs by the year 2000, its potential, although unevenly distributed, is much greater in the long term The Community supports electricity generation projects intended either to supply the grid or to provide power directly to users in a decentralized manner Special attention is paid to increasing yield, to reducing investment costs, and to solving legislative, administrative and environmental problems Between 1983 and 1985, the Community awarded 20 million ECU for the implementation of 80 wind projects Among the first successes were three wind energy installations

linked to national grids, in Masnedø (Denmark), Ilfracombe (United Kingdom) and Medemblik (Netherlands), the last achieves an output of one megawatt Among the decentralized applications is a wind-powered generator which heats a greenhouse belonging to the Irish Agricultural Institute

☐ *Hydrolectric power* Low-power (less than 3 000 kW) and generally low-head hydraulic resources are not without interest The Community intends to develop the activity in this sector which it began in 1984 and which has already led to 10 million ECU being granted to 48 projects Priority objectives the improvement and standardization of equipment, the use of new materials, the modernization of control and management techniques, increased profitability and respect for the environment

Substituting for hydrocarbons

The Community supports projects which enable Europe's energy sources to be diversified by substituting other non-renewable sources for oil and natural gas It is interested in new techniques for the use of electricity, and in the transmission, distribution and storage of heat for industry and for urban heating systems Also of interest are new processes for the combustion, handling, transportation, treatment and storage of solid fuels (coal, lignite, peat and their residues) Particular attention is paid to problems linked to protection of the environment and to management of demand for electricity or heat Between 1978 and 1985, the Community granted 71 million ECU in aid to 68 substitution projects

Liquefaction and gasification of solid fuels

The replacement of petroleum by products obtained from the liquefaction and gasification of solid fuels is also a prime objective in the drive to diversify and reduce external dependence The Community granted 151 million ECU in all to 38 projects of this kind, between 1978 and 1985 Most of the projects were for converting coal into gas products These products can serve as raw material for large areas of the chemical industry, or can be used to generate electricity in a combined cycle linking gas and steam turbines The projects supported cover all the principal technologies as well as a wide range of capacity Among the most advanced are those of British Gas-Lurgi, Rheinbraun and Krupp-Koppers Other projects, further away from commercialization but no less essential, are aimed at converting coal into liquid products which are among the few alternatives to petrol for fuelling cars Finally, two projects (at present merged into one, involving several Member States) are working towards something that is even further away in the future the underground gasification of significant coal reserves which the Community still possesses, but which are situated at a great depth and cannot be exploited at the moment ■

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A European Energy Strategy

European File

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June-July 1984

Energy in all its forms — electricity, oil, gas, liquid and solid fuels — is a vital factor in industry, agriculture, commerce, domestic comfort and leisure activities The availability of energy supplies is no longer absolutely guaranteed The crisis in the Middle East in 1973 caused considerable supply problems One of the causes of the world recession was the rise in oil prices, which increased fourfold in 1973-4 and doubled in 1979 More recently, the war between Iran and Iraq has revived anxiety [1]

The European Community and its Member States face a major challenge The Community is the world's largest oil importer It relies for more than one-third of its supplies on three countries, Saudi-Arabia, Libya and Nigeria In 1983 oil still accounted for nearly 50% of European energy consumption (against 63% in 1973) The Community's oil bill, in dollars, has increased fivefold since 1973, despite a 50% reduction in net imports This cut in imports results partly from an increase in domestic production (mainly from the North Sea) and partly from the replacement of oil with other forms of energy and the more economic use of fuel But it also reflects a fall in demand, caused by the industrial recession

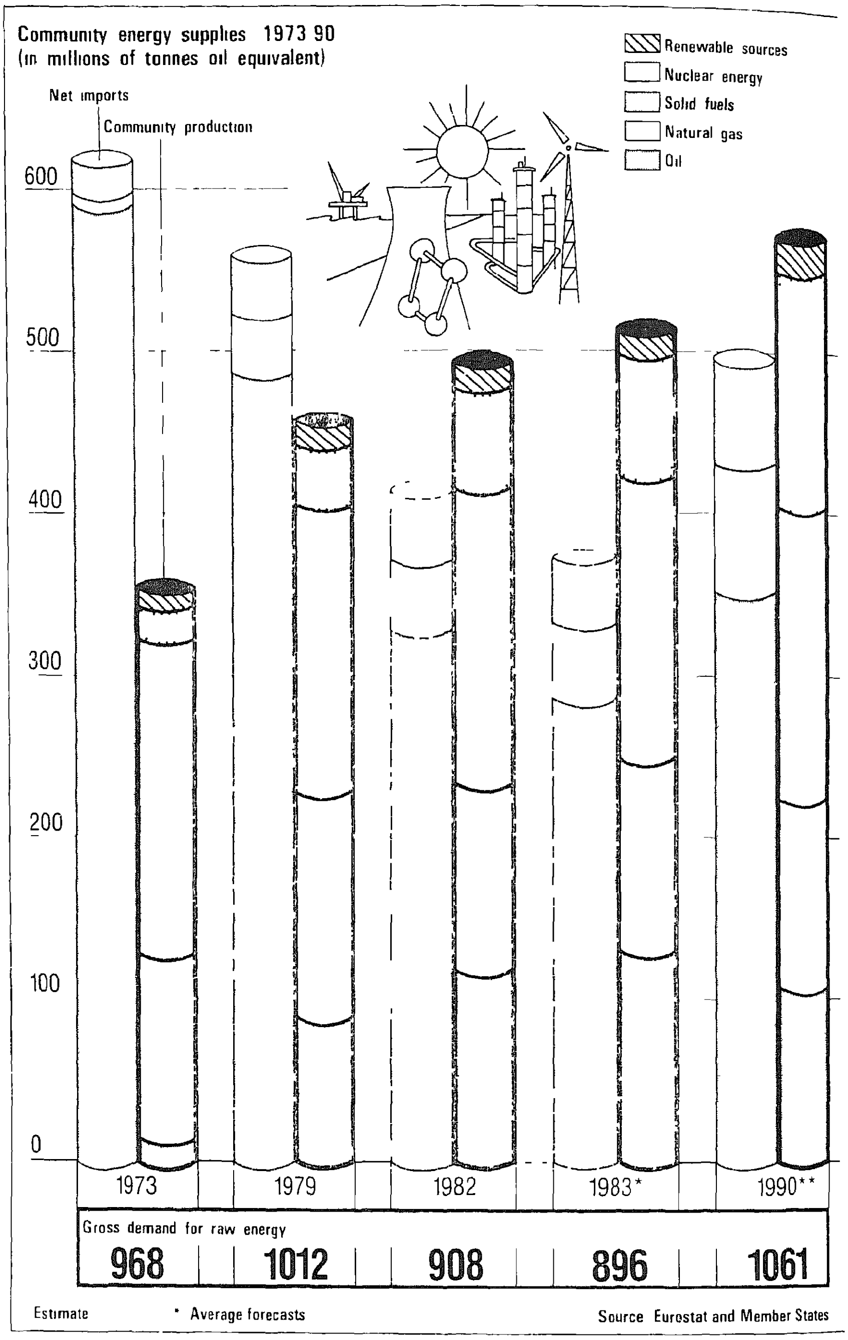
The main elements of Community energy strategy

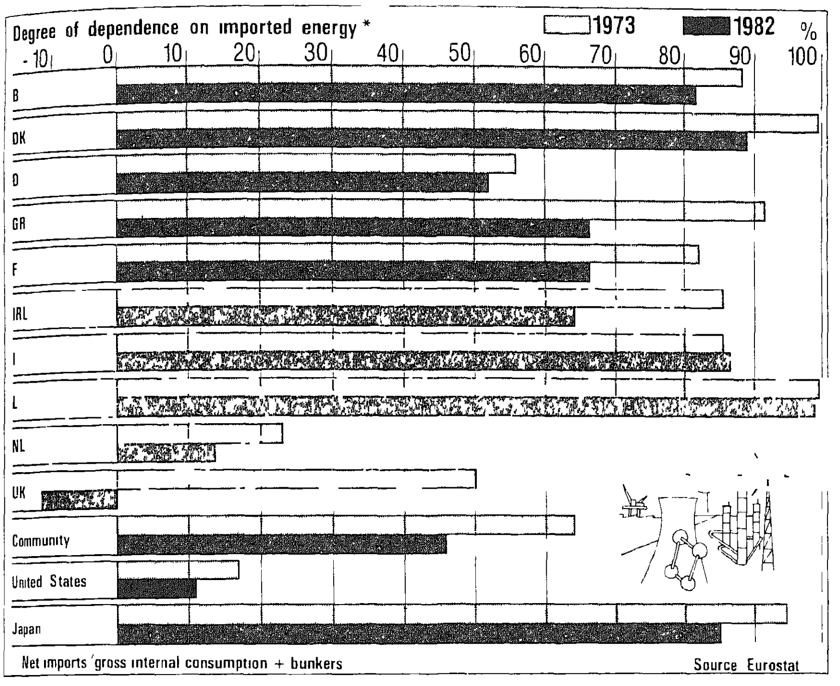
The oil challenge poses problems for the economies of Community countries which they must face in unison A foundation for this solidarity is provided by the Treaties which set up the European Coal and Steel Community (ECSC) in 1951 and the European Atomic Energy Community (Euratom) in 1957 A solution to the energy problems of the present day must lie at the heart of any successful strategy for reducing unemployment and inflation and giving new impetus to manufacturing industry In facing up to these problems, Europeans share a common destiny, a common strategy can give them renewed hope for the future Thus

- Although their dependence on energy imports varies — the Netherlands and the United Kingdom have considerable domestic resources — all Community countries are very vulnerable Their economic prosperity depends not only on their own energy supplies, but in the context of the Community's common trading market, on the level of economic activity in other Member States This can clearly be adversely affected by high import bills for oil The centralization of all decisions and policies is neither desirable nor possible Specific national considerations must be scrupulously respected But all Member States have a common interest in ensuring that their energy policies are moving towards the same Community goals

- European action is a guarantee of greater effectiveness It avoids the dispersal and duplication of scarce resources in the research field It provides a larger market for new technologies It can encourage continuity in investment and

[1] This file updates and replaces our No 8/82


Community energy supplies 1973 90
(in millions of tonnes oil equivalent)
Net imports
Community production
Renewable sources
Nuclear energy
Solid fuels
Natural gas
Oil
600
500
400
300
200
100
0
1973
1979
1982
1983*
1990**
Gross demand for raw energy
968
1012
908
896
1061
Estimate
* Average forecasts
Source Eurostat and Member States



taxation policy, despite the changing economic circumstances in Member States The Community, speaking with one voice, is more likely to be heeded by oil exporting countries to the same degree as other large-scale importers It can also help the non oil-producing countries of the Third World to solve their own energy problems

For a number of years the Community and its Member States have been gradually, probably too gradually, developing a common energy policy This common action is based on targets set in 1974, and elaborated in 1980 with 1990 as the target date The aim is to reduce, through more economic use of energy, the relation between the growth in energy consumption and the growth of gross domestic product to at least 0 7 Member States are expected to conduct broadly equivalent programmes of energy savings Oil consumption is to be reduced to about 40% of gross raw energy consumption Solid fuels (coal, lignite and peat) and nuclear power must take over between 70% and 75% of electricity generation The increased use of renewable forms of energy must be encouraged Energy pricing policy must be compatible with these Community targets

The Community has to use all means at its disposable to reduce dependance on oil By 1990 it must increase gas consumption (now accounting for 18% of energy needs) through increased imports Use of solid fuels must be similarly encouraged Renewable energy sources must be developed (solar, geothermal and hydraulic

power), although the growth potential in this area is comparatively small The Community must also promote the use of nuclear energy It cannot afford to ignore any alternative to oil Nuclear power is also a potentially important factor in increased industrial competitiveness One kilo of uranium produces as much energy as 10 tonnes of oil, for one-third of the price Fast breeder reactors could produce the equivalent of 600 tonnes when they enter in service The nuclear share of total electricity production was expected to top 27% in 1973 (9% of total energy needs, but with wide disparities between Member States) By 1990 it must reach 40% At the same time, however, the protection of health and the environ ment must be a *sine qua non* of the development of nuclear power The Community is undertaking massive research programmes in this area

These Community objectives can only be attained by the coordinated efforts of the Member States and by action at Community level, where this is more effective Action must concentrate on five priority areas investment, prices and taxation, research and development and demonstration projects, safety measures against market disturbances and external relations

Promoting investment

The key to the modernization and the continued competitiveness of European industry is the diversification and more economic use of energy supplies But this requires massive investment which must not be deflected by short-term economic and budgetary problems At present, Community investment in energy is substan tially below that in the United States and Japan The development of the coal and nuclear industries has often been held back by public concern for safety and the environment Investment in energy saving has also encountered obstacles uncer tainty about the relative long-term cost of different energy forms, the slow return on investment, inadequate training and information, inflexible financing systems, high and unstable interest rates, and the proliferation of national regulations which constrict the potential market In the unfavourable financial and economic conditions of the present day, these problems are particularly acute in high energy consumption industries, the building trade, small and medium-size businesses and the infrastructure sector Action is needed in a number of areas

□ The improvement of the economic climate,

□ More consistent and logical energy pricing and taxation policies,

□ The promotion of nuclear energy and solid fuels by extending Community activities in safety research and standards and providing balanced information on the advantages and disadvantages of the different options,

□ The promotion of new forms of energy, modern energy technology and energy savings by boosting research, development and demonstration programmes, encouraging better information and training of the public and specialists alike, modifying standards and other regulations and improving financial conditions

such as subsidies and other cash incentives Decision-making must be decentralized but the Community market must be opened up by the adoption of common standards Existing Community action in this field includes measures to increase the effectiveness of heat-pumps, the insulation of buildings, fuel consumption in cars and information on the power-consumption of household electrical goods

□ The promotion of investment in energy

- The Community already contributes to the financing of nuclear power-stations, equipment for producing and transporting hydro-carbons (oil and gas pipelines), the re-equipment and modernization of coalmines, the conversion of oil-fired plants to coal, the inter-connection of Community and neighbouring electricity power grids and many energy saving projects in industry, public buildings and district heating systems In 1983 loans to the energy sector from the ECSC, Euratom, the European Investment Bank and the New Community Instrument (NIC) totalled about 2 6 billion ECUs [1]

- But much more extensive action is needed In the nuclear sector – whose targets, investments and impact on economic conditions are regularly described in Commission publications – action is needed to encourage uranium prospecting, promote the construction of power stations (with help from the EIB, NIC and Euratom whose lending capacity has been doubled), and improve facilities for the temporary storage and treatment of radioactive material by coordinating, as far as possible, the activities of Member States In the solid fuels sector, it is necessary to promote the conversion of oil-fired boilers in industry, public buildings and district heating systems, develop handling facilities in ports and adapt other transport facilities and modernize Community coalmines, many of which could be made profitable, given increased investment and productivity Action is also needed to encourage the discovery and development of new natural gas fields in the Community and promote the development of new forms of energy, through a Community-wide approach which will allow the speediest possible progress in Member States Finally, Community farmers must be encouraged to grow energy-producing crops (fuel for motor vehicles can be obtained from certain vegetables) and to adopt energy saving methods and techniques

- Special efforts are needed in energy saving investment in this area could top 250 billion ECUs by 1990, or 1% of the gross domestic product of the Community (compared to 0 4% at present) It has been estimated that this investment could create between 300 000 and 500 000 new jobs by making Community firms more energy-efficient, modern and competitive, by creating markets for new products and techniques and improving the Community's balance of payments But to make this possible Member States must

[1] 1 ECU (European currency unit) = about £ 0 58, Ir £ 0 73 or US $ 0 8 (at exchange rates current on 10 May 1984)

unite and coordinate their efforts The Community is therefore encouraging all Member countries to adopt the systems and methods (improvements to financial incentives, training and information) which have shown good results in some countries already Thanks to the strengthening of the loan capacity of the NIC and the EIB, the Community will be able to step up its own contribution to these efforts The intention is to promote the convergence of the economies of Community countries by ensuring that priority is given to projects in regions where the needs are greatest and the resources the weakest

The adoption of a realistic and transparent pricing policy

Energy accounts for a varying, but often substantial, part of industrial costs Energy prices therefore affect the relative competivity of industry, both in Member States and between the Community and the rest of the world At the same time, energy prices must accurately reflect the likely trends of the market in the long term and encourage consumers to invest in appropriate energy forms Anything which tends artificially to influence prices must be clearly identified and price disparities between Member States gradually reduced, where they do not result from genuine differences in costs of production

☐ The first stage in achieving greater coherence in pricing policy and practices is greater market transparency The Community already monitors trends in many forms of energy These efforts must be strengthened in areas where price transparency causes problems gas, electricity, supplies to industry etc The publication of six monthly energy price bulletins by the European Commission is a step in this direction

☐ But more must be done Energy prices are too often influenced by disparities between policies in the Member States and the financial structure of energy undertakings and their accounting methods Prices are sometimes even kept deliberately above their economic level, either for all consumers or for particular types of consumers The Commission wants to see a more logical system of price-fixing for each form of energy It wants to create a genuinely common energy market, where price differences between countries will reflect only local advantages (quality of equipment, transport costs, etc) or priorities which conform with Community objectives (reduced dependence on imported oil, etc) Other measures are also necessary to ensure that short-term economic and national price policies do not conflict with common long-term objectives

Taxation can, at the same time, have a considerable influence on the final price to the energy user The oil sector is a case in point The Commission is urging a gradual reduction in the disparities between national taxation systems, in order to limit distortions of competition Taxation should not be used to create differences in energy prices between one country and another It should not become an obstacle to the adjustment of prices to conform with long-term market conditions

or the creation of a price hierarchy for different energy forms which will encourage energy saving and the displacement of oil

The promotion of research, development and demonstration projects

Research, development and demonstration projects — the latter providing a testing ground of the industrial and commercial viability of new methods and technologies — are a key factor in industrial innovation and economic growth Considerable resources are required Community action allows greater common returns on investment, the sponsorship of projects too large for a single Member State, the avoidance of waste of resources through duplication, a wider dissemination of results and a more effective use of the continental-scale trading market

- In 1983 total Community expenditure on research, industrial development and demonstration projects in the energy sector topped 400 million ECUs Community spending represented 10% of total public investment in energy research in the Member States A still larger proportion of this investment is coordinated by the Community Major programmes include nuclear safety (the safety of reactors, management of radioactive waste, monitoring of fissionable materials, radioactive protection, etc), controlled nuclear fusion (all Community research in this area has been combined), solid fuels and new forms of energy Technological and demonstration projects have been launched in areas such as hydrocarbons (the exploration of underwater oil and gas fields), solid fuels (the liquefaction and gasification of coal), geothermal, biomass and solar energy and energy saving methods In March 1984 the Council of Ministers approved a programme of demonstration projects worth 295 million ECUs between 1983 and 1985

- But once again it is necessary to go further The European Commission has proposed a substantial increase in Community spending on research and demonstration in the next few years as part of a five year action programme for energy and energy research Further action is needed in a number of areas energy savings, renewable energy sources, nuclear fusion, nuclear fission (especially the management and storage of radioactive waste), and solid fuels (the solution of ecological problems, conversion into gas etc) Going beyond research and demonstration proper, action is needed to ensure that the dissemination of knowledge is better organized and that Community standards allow the profitable and effective use of new technologies and the renewal of industrial equipment

Protection against disruption of the energy market

Events in Iran in 1979 showed how a limited and short-lived reduction in oil supplies, or just the threat of such a reduction, can cause an abrupt rise in prices, irrespective of market realities Community solidarity can provide a shield against problems of this kind

☐ A system of fuel stocks at power stations (enough for 30 days supply) has already been introduced

☐ Another system of buffer stocks has been introduced in the oil market (90 days supply) to insure against any substantial shortfall in deliveries In the case of crisis, a system of monitoring trade in oil and a gradual reduction in consumption has also been set up This system has been agreed at Community level in coordination with the other great industrial powers (the United States, Japan etc) The Community has, in addition, agreed a range of other measures which can rapidly be triggered if the oil market is disrupted by a short-term interruption of supplies Here again, the cooperation of all industrialized countries would be advisable

☐ In the solid fuels and gas sectors, stocks and safety measures would also be useful in the event of crisis The Commission has suggested that certain gas fields should be kept in reserve, the inter-linking of distribution networks and the increased use of suspendable supply contracts with major users, who are capable of switching to coal or oil

A united front internationally

Security of energy supplies does not only mean internal safeguard measures It must also mean the diversification of imports, the establishment of stable relations with exporting countries and a dialogue with other major importers Community strategy must therefore extend to international relations If the 273 million Community consumers speak with one voice, they have a better chance of being heard

☐ In the nuclear sector, the Community has already signed agreements with the principle exporting countries (Australia, Canada, the United States) which will ensure a certain stability of supplies Further efforts are needed to ensure that there is no discrimination between consumers of nuclear fuels within the Community In the coal sector, consultations and long-term agreements are needed with the major exporting countries, who include the countries listed above In the gas sector, the Community is increasingly dependent on external supplies (from Algeria, Norway, the USSR etc) The Community should adopt a common approach before agreeing major contracts

☐ The Community can also help to relieve energy shortages by increasing its cooperation with other major importing countries At the Tokyo summit in 1979, the United States and Japan reached an agreement with the Community to restrict oil imports up to 1985 Attention must also be given to the non-oil *producing countries of the Third World, whose needs are placing increasing* pressure on the world market The Community and its Member States are already active in energy developments in the Third World Their loans and grants in this area are already running at over 700 million ECUs a year These

efforts must be increased by encouraging investment by European firms and boosting public investment in a number of areas the assessment of needs and resources, prospecting for and developing new oil, gas and coal fields, the popularization of solar energy and the introduction of energy saving methods and training courses for technicians etc

△

Community energy strategy is closely related to other European policies, whether in external relations, research, industry, economic affairs, or employment In all these areas, the coordinated efforts of the Community and its Member States must lift our Europe, as quickly as possible, and under the best possible conditions, from the economic recession ■

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ENERGY IN EUROPE

Energy policies and trends in the European Community

Number 2 August 1985

Commission of the European Communities ☐ Directorate-General for Energy

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ENERGY
IN EUROPE

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Contents

Abbreviations and symbols

:	no data available
-	nil
0	figure less than half the unit used
kg oe	kilogram of oil equivalent (41 860 kjoules NCV/kg)
M	million (10^6)
t	tonne (metric ton)
t = t	tonne for tonne
toe	tonne of oil equivalent (41 860 kjoules NCV/kg)
MW	megawatt = 10^3 kWh
kWh	kilowatt hour
GWh	gigawatt hour = 10^6 kWh
J	joule
kJ	kilojoule
TJ	terajoule = 10^9 kJ
NCV	net calorific value
GCV	gross calorific value
ECU	European currency unit
EUR 10	Total of member countries of the EC
I or —	discontinuity in series
of which	the words 'of which' indicate the presence of all the subdivisions of the total
among which	the words 'among which' indicate the presence of certain subdivisions only

Is the general public in favour of a Community energy policy?

Public opinion in the European Community on energy issues in 1984

Faits et Opinions, the public opinion pollsters, have produced a detailed report, on their own responsibility, about a survey they conducted amongst 9 900 citizens in the ten Member States in October 1984 for the Commission A similar survey was carried out in October 1982 and published in 1983

Commission staff felt that it would be helpful if they, for their part, picked out the general findings in the report which cast most light on the Community's energy policy

The gravity of the energy problem

Over half the Europeans interviewed considered the energy problem serious and thought that it would still be virtually the same in 10 years' time However, their pessimism has abated slightly since two years ago Opinions differ appreciably from one Member State to another, with the Italians the most pessimistic and the Dutch and Danish the least concerned

Percentage of public support for joint action on energy by the Community countries (Oct 84)

Belgique/België	78
Danmark	63
BR Deutschland	71
Ελλάδα	57
France	74
Ireland	72
Italia	78
Luxembourg	87
Nederland	87
United Kingdom	53
EUR 10	71

Dependence on imported energy supplies

Europe in general, and each individual Member State in particular, seems highly aware of its dependence on imported energy supplies today (and of the disparities between one Member State and another) There is a clear correlation between this awareness on the one hand and the realization of the seriousness of the problem on the other

General policy questions

Given the seriousness of the situation and the relatively heavy dependence on imported energy supplies, two general lines of policy are open

(a) **Advantages of joint action.** More than two out of every three Europeans favoured action by the Community on energy policy, whereas only one in five preferred separate national action In every Member State, the majority favoured action by the Community This advantage of the European dimension was borne out by the respondents' confidence in the security of supplies from other parts of the Community

(b) **The need for public spending** in this field was broadly accepted Over two thirds of the respondents accepted the principle of financial aid for energy research and energy-saving schemes However, in reply to the specific question of cutting down energy consumption, the majority preferred recommendations rather than statutory obligations (Greece and Italy being the only exceptions)

General priorities

Almost one European in two favours measures to make Europe less dependent on **imported energy supplies.** None the less just under one in five put the cheapest possible price before the risk of becoming more dependent on foreign supplies

Interestingly, **environmental protection** is one of the priorities of almost one European in three, and even of the majority of those questioned in Denmark, Germany, Luxembourg and the Netherlands

Priorities for specific sectors

(a) Energy saving

Over two thirds of the respondents said that a great deal of energy was wasted This was clearly the feeling in every Member State, albeit to differing degrees

However, less than one European in two claimed personally to have done anything to save energy over the last few years in any of the three main areas listed (insulation, turning down the heating and driving more economically) On average, only one in four felt that they could personally make more savings in any of these three areas than they were already

Slightly over one European in 10 voted energy saving the **top policy priority** to overcome the supply problems, with a quarter of the respondents placing it second This is low considering the still untapped potential in this area and seems to contradict the feeling of those questioned that a great deal of energy is still wasted One conclusion which can be drawn is that it is essential to keep consumers better-informed of ways of reducing wastage and of the benefits which they can expect from them

As for the means to be employed, the majority preferred incentives to restrictions by law (except in Italy and Greece) On the other hand a very large majority (over three quarters) felt that financial help to consumers wishing to install energy-saving equipment was justified, with the replies broadly the same in each Member State

(b) Oil

Oil has a poor image The vast majority of the Europeans interviewed rated it the least reliable of all the sources listed, in terms of security of suply, price stability and pollution risks

Two other findings corroborate this Eight out of every ten people in Europe as a whole (and an even higher proportion in France, Germany and Italy) feel that oil consumption for electricity generation should be cut down substantially in order to reduce dependence on oil Another indication is that although one in every three Europeans has an oil-fired heating system at home, half would prefer to convert to another fuel

(c) Natural gas

One in four Europeans ranked natural gas the stablest-priced, safest form of energy One in five also saw it as the fuel posing the lowest pollution risk This preference for natural gas is particularly marked in Denmark, Ireland, the Netherlands and the United Kingdom (In both the United Kingdom and Ireland, natural gas is even preferred to renewable sources as a means of combating pollution)

(d) Solid fuels

Solid fuels also have a fairly good image, at least on price stability and security of supply Almost one in five Europeans put them first on both these counts, giving solid fuels comparable support to natural gas, nuclear energy and renewable sources This support is stronger still in Belgium, Ireland, Luxembourg and Germany, whereas the Netherlands and Denmark are the least enthusiastic

On the other hand, the pollution risks are generally acknowledged, with only one European in 10 voting solid fuels the best means of combating pollution The assessment of the risks of living close to a coal-fired power station are also significantly higher than in the 1982 survey

The same relative preference for solid fuels comes through in the question on electricity generation, where solid fuels have a slight edge over nuclear power in terms of price stability and security of supply and are more decisively preferred from the point of view of pollution risks, compared to nuclear There is a marked preference for solid fuels in Belgium, Denmark, Greece, Ireland and Luxembourg

(e) Nuclear power

Nuclear power's image differs widely

The proportion of citizens describing nuclear power stations as 'worthwhile' (43%) or saying that the risks involved were 'unacceptable' (38%) were both higher than in the 1978 and 1982 surveys The proportion of 'don't knows' has gone down

As mentioned earlier, nuclear power was ranked almost equal to solid fuels on price stability and security of supply for electricity generation. But only one country — France — gave nuclear power the lead on both price stability and security of supply.

There are still substantial reservations about using nuclear power. Overall, just under one in every two Europeans feels that the risks must be accepted. Opinion is generally divided, except in France and Germany, where the balance is clearly in favour of nuclear power, and in the countries with no nuclear installations, namely Denmark, Greece, Ireland and Luxembourg, where there is clearer opposition.

Almost two in three Europeans feel that nuclear power stations pose as great a hazard to local residents as explosives factories (but less than a chemical factory).

The greatest concerns seem to be the risks of storage of radioactive waste (two Europeans out of every three), followed by radioactive emissions (roughly one in two).

(f) Electricity

The respondents expected demand for electricity in their countries to continue to grow in future. This agrees remarkably with expert opinion. In addition, the public not only feels that the energy problems are serious but also expects electricity consumption to increase.

(g) Alternative sources

There is nothing surprising in the finding that one in every two Europeans in every Member State except the United Kingdom and Ireland (where natural gas is preferred) thought that 'soft' energy is the best means of combating pollution.

What is more surprising is that one European in five said that alternative sources are the stablest priced. (The proportion rose to one in three in Greece and one in four in France and Italy, though Ireland and the United Kingdom both remain very sceptical.)

Finally, the much more surprising finding is that one European in every two sees alternative energy sources as the most appropriate solution to the supply problems and energy difficulties.

The information provided by the survey is clearly of interest, but any assessment must of necessity be cautious. A copy of the full report can be obtained from the Commission (Mr Tiberi, tel. Brussels 235 22 81).

The opinions expressed (on the basis of a questionnaire) reflect the climate of opinion at a particular moment in time and are given 'raw' and without any critical judgment having being made. The Commission will subsequently have the task of evaluating the opinions to see how they can be taken into account in the proposals it makes concerning energy policy.

New Community energy objectives

Although the world energy situation is reasonably calm, at least for the time being, the ten Member States of the European Community are still working to achieve common energy objectives. What is more, those objectives are well on the way to being fulfilled The lesson of the past, however, is that it would be fatal to assume that the future energy situation will now look after itself We have seen how quickly a favourable energy situation can turn into a state of crisis. Sustained efforts will be needed to ensure that this does not happen again. The European Commission has therefore suggested that the Community should underline this need by adopting new energy objectives for the year 1995.[1]

The point of having common energy objectives is not just to give substance to the existence of a Community energy policy Common objectives represent a political commitment by all member countries to continue with effective policies, and they lay down a common direction which these policies will take The objectives have always been backed up by regular monitoring of progress The Commission has been given this particular responsibility and carries out, most recently in 1984,[2] regular reviews of the energy situation and energy policies in each Member State

For the last five years the ten member countries of the Community have been working on the basis of 1990 objectives, which were adopted by the Council in June 1980 These included, inter alia, commitments to

(i) reduce the share of oil in the Community's total energy consumption to about 40%,

(ii) increase the share of coal and nuclear energy in the fuels used for electricity generation to at least 70-75%,

(iii) reduce the ratio between economic growth and growth in energy demand to less than 0 7

The 1984 review of Member States' programmes showed that all three of these objectives were likely to be achieved by 1990 Indeed, the coal/nuclear target has already been met More generally, these improvements illustrate the very considerable progress which has been made in the Community since the 1973/74 oil crisis In 1984, after 11 years of economic growth, total energy consumption in the Community was 2% lower than in 1973 Oil consumption was down by 25% and net oil imports had been cut from 596 Mtoe in 1973 to 299 Mtoe in 1984 Nuclear capacity in the Community had more than tripled to 53 gigawatts (GW) at the end of last year

[1] COM(85) 245 final

[2] COM(84) 87 and 88 final

But energy needs will of course continue to grow during the rest of this century It is essential that these needs should be met efficiently and with a diversified and secure pattern of supplies Energy is a field in which the lead times for many decisions and investments are notoriously long The 1990 objectives are therefore starting to lose their relevance The Community should now be looking beyond the end of this decade to ensure that the necessary decisions needed for the 1990s are taken, and taken in good time This is the case for adopting new objectives to guide energy policies during the next 10 years

The new objectives suggested by the Commission are designed to take account both of **horizontal** requirements, that is essential guidelines which should be followed in all energy sectors, and of **sectoral** needs They have been derived from the Commission's own assessment of the current situation and past trends, set out at length in the 1984 review, and from its recently-published Energy 2000 study[3] which looked at a range of possible developments over the rest of this century The results of the latter study were summarized in the last issue of *Energy in Europe*

On the **horizontal level**, the Commission has suggested the following seven objectives

1. External relations:

Development of external energy relations through a coordinated Community approach

[3] SEC(85) 324 final

2. Internal market:

Greater integration of the Community energy market to improve supply security, reduce overall costs and enhance economic efficiency through increased competition

3. Energy security:

Reduction of security risks through indigenous energy production, diversification of supply sources, greater system flexibility and effective contingency measures

4. Energy pricing:

Application of the Community's energy pricing principles in all sectors of consumption

5. The environment:

The balanced pursuit of both energy and environmental aims, particularly through the use of the best available and cost-effective control technologies and through improvements in energy efficiency

6. Regional development:

Reinforcement of Community energy policy through appropriate measures in less favoured regions

7. Technology and innovation:

Continued promotion of innovative energy technologies through research, development and demonstration

The case for each of these seven basic horizontal needs is perhaps self-evident In an inter-dependent world energy economy there will always be a need to maintain good external **relations** and encourage recognition of the common interest all nations have in ensuring trade, growth and stability Reinforcement of the **internal market** must be an economic aim for the Community in energy as much as in other fields No energy policy can ever be effective without paying attention both to **energy security** and to the importance of realistic **energy pricing** for the effective operation of the market **Environmental aims** must in future be an integral part of energy decisions, and the reverse holds true as well. The same type of interaction is true in the **regional development** field, not least because the energy situation in many of the Community's poorer regions is particularly vulnerable And, lastly, the future of the Community's energy situation will depend a great deal on the development and, above all, on the commercialisation of **new energy technologies.**

The **sectoral objectives** suggested by the Commission amount to a series of signposts towards the type of energy situation which would provide the Community with an acceptable level of security and efficiency in ten years' time The degree of effort which will be needed to achieve these objectives will of course depend on how economic trends and energy markets develop. If these developments are favourable, the objectives may be achievable with present policies But it is more likely, given the uncertainties and scope for fairly rapid change which characterise the energy field, that stronger policies will be needed from time to time to keep the Community on its chosen course Changes in the price of oil relative to other fuels could be an important example of this type of change. The major significance of the proposed objectives, therefore, is that their existence would signal the need for stronger action when market trends started to diverge from the path they set

The desirable pattern of development indicated by the proposed sectoral objectives, therefore, is one in which the growth in energy consumption would be held down by continuing gains in energy efficiency, and in which reliance on oil would continue to be restrained by expanded use of coal and other solid fuels, natural gas, nuclear power and renewable sources On the supply side, efforts to discover and bring on stream new oil and gas fields will clearly need to be given priority, as well as the continued expansion of the nuclear programme and the restructuring of the Community's coal mining industries

With these aims in mind, *the specific sectoral objectives* put forward by the Commission are

1. Energy efficiency:

Continued improvement of energy efficiency in all sectors to achieve at least a further 25% reduction in the overall intensity of final energy demand by 1995

2. Oil imports:

To maintain net oil imports at less than one-third of total energy consumption in 1995 by continued oil substitution and by promotion of exploration and production within the Community

3. Natural gas:

To maintain and if possible increase the market share of natural gas on the basis of a secure and diversified pattern of supplies

4. Solid fuels:

To maintain and if possible increase the present market share for solid fuels Continued restructuring of the Community's solid fuels production industries

5. Electricity:

Continued priority for the use of solid fuels and nuclear energy in the electricity sector to ensure that not more than 10% of electricity is generated from hydrocarbons in 1995 Approximately 40% of electricity output in 1995 to be generated from nuclear energy.

6. Renewable energies:

To increase the efforts already underway to develop and commercialise new and renewable energies with a view to tripling their displacement of conventional fuels by the end of the century, enabling them thereby to make a significant contribution to the Community's energy requirements

These are of course Community level objectives rather than objectives which will apply individually to each member country There are naturally major differences from one country to another in terms of energy resources, geography, demand patterns, administrative structures and policy choices But the achievement of the common objectives will require equivalently strong efforts in each country One important aspect of the objectives is that they will provide the basis for regular monitoring by the Commission of energy policies in the Member States

The Commission has invited the Council to ratify the new objectives in the form of an agreed Council Resolution Its proposals were discussed for the first time by the Energy Council on 20 June, where initial reactions at the political level were generally favourable to the idea of making a renewed commitment to sound energy policies over the longer term The details of the Commission's proposals will now be discussed at working level and brought back to the next Energy Council in the second half of 1985 Since the objectives will apply to the expanded Community of Twelve, the proposals will also now be discussed with Spain and Portugal

Ultimately, the adoption of new energy objectives for 1995 will be a signal to the outside world that the Community intends to keep its energy economy in order, and therefore to maintain the contribution it has been making to improve the world energy situation Above all, the objectives and their implementation will provide the secure energy base which the Community will need to achieve its economic and social aims The recent opinion survey discussed in another article in this issue of Energy in Europe shows that the European public has not forgotten this need and that there is wide public support in every country for taking effective action at the level of the Community itself

Energy research and development (R&D) in the European Community

At almost 50% of the total Community R, D&D [1] volume planned for the period 1984-87 the Community goal 'Improving the management of energy resources' is the major one among the seven goals in the framework programme for the scientific and technical activities of the Community [1]

This general energy goal comprises four broad objectives for energy research concerning **nuclear fission, fusion, renewable energies** and **rational use of energy**. A number of R, D&D programmes, carried out or managed by several Directorates-General of the Commission, work towards realization of these objectives The major contributions come from a number of dedicated energy programmes, ranging from research to demonstration activities An additional, smaller contribution comes from a number of other Community R,D&D programmes, dedicated to other, non-energy sectors, such as 'materials' for instance which usually contain a relatively small energy-aspect In turn, the dedicated energy programmes frequently contribute to other objectives, such as **'protecting the environment'**.

Taking this into account, the overall resources proposed for energy R, D&D during the period 1984-87 as well as the state of implementation of this proposal by means of both dedicated programmes and contribution from other proposals, by March 1985, are shown in Table 1

Table 1 — **Goal of the framework programme 1984-87 on Community R, D&D.**
Improving the management of energy resources

Objectives	Proposed for 1984-87	Status on 1 3 1985
1 Developing nuclear fission energy	460 [1]	410 [1]
2 Controlled thermonuclear fusion	480	591
3 Developing renewable energy sources	310	122
4 Rational use of energy	520	195
	1 770	1 318

(¹) 1982 value

It should be noted that as a result of the guidelines adopted by the Council on 20 June 1985 on the duration and on the amounts estimated necessary for the demonstration projects, the figures concerning the status of the last two objectives in Table 1 will increase

The energy-dedicated programmes, which account for the major share of the state of implementation of the various objectives are shown in the following Table 2 which reflects the situation of March 1985

The R&D activities are executed either in-house by the Joint Research Centre, or in laboratories of industry, national centres or universities in the Member States on the basis of cost-shared contract research, administered by Commission departments

Energy in Europe will devote considerable attention in the future, as it has in the past, to Community action administered by the Directorate-General for Energy to promote demonstration projects in the exploitation of alternative energy sources, the rational use of energy and the liquefaction and gasification of solid fuels

This article simply gives a brief overview of energy R&D activity financed by the Community in the fields of fission, fusion and non-nuclear energies [2]

1. Fission nuclear energy

Energy from nuclear fission continues to play an expanding role in meeting the Community's energy requirements It is already used on a large scale in some countries and its use is expanding throughout the Community At Community level this implies concomitant research efforts to help meet public concern that man and the environment should be protected against the risks of escaping radioactivity Action by the Community has been and still is concentrated on the operating safety of nuclear power stations and of fuel cycle installations

The main objectives of the **reactor safety** programmes are accident prevention on the one hand, and accident analysis, control and mitigation of accident consequences, on the other Accident prevention addresses the problems

[1] Official Journal C 208, 4 8 1983 on the Council Resolution of 25 July 1983 on framework programmes for Community research, development and demonstration activities and a first framework programme 1984-87

[2] For more detailed information on any of these programmes, please contact DG XII Scientific Coordination Tel Brussels 235 67 12 or Brussels 235 69 16

of continuous improvements of design and fabrication quality for reactor components and systems Thereby the operational reliability and hence safety and economy of nuclear power plants are increased The major effort is devoted to risk and reliability assessment, and to studies on the integrity of components and systems In the area of accident analysis, control and mitigation of accident consequences, the effort is directed to develop models and computer codes which describe the phenomena occurring during the course of an accident Large test risks are run to produce experimental data for code verification

The emphasis on the above two main research areas is slightly different for the two types of reactors — LWRs (light water reactors) and LMFBRs (liquid metal fast breeder reactors) — owing to their different stages of development

The objective of the reactor development and advance technologies activity is mainly to perform compariso analysis and synthesis studies in the field of coordinatic research and of harmonization of safety methodologie codes and standards — both for LWR and LMFB systems In the light of advanced technologies, compar son, analysis and synthesis studies are also carried out

The management and storage of radioactive waste prc ramme is oriented towards optimization of radioacti waste management with respect to safety and cost Mo over, existing methods are improved and processes de loped for treatment, conditioning and handling of dioactive wastes arising from all stages of the nuclear fi cycle Concerning final storage of high-level wastes a long-lived wastes, the effort aims at evaluation and monstration of feasibility of final storage in various g

Table 2 — Energy

		1984	1985	1986	1987	1988	1989	1990
Nuclear fission								
Reactor safety	JRC			192/1				
Reactor development and advanced technologies	[2]	0 93	1 1					
Management and storage of radioactive waste	SCA	43/10			62/12			
Radioactive waste management	JRC			49/1				
Fissile materials control and management	JRC			45/51				
Nuclear fuel and actinide research	JRC			66/1				
decomissioning of nuclear plants	SCA			12 1/3				
utilization of HFR reactor	JRC			59/1				
Fusion								
Thermonuclear fusion-JET or general programme	SCA			690/270	690/270			
Fusion technology	JRC	{	46 5/1	46 5/1				
Specific appropriations for projects of European significance	JRC		3					
Non-nuclear energies								
Energy (non-nuclear)	SCA				175/40			
Solar systems testing methods	JRC		22 1					
Habitat energy management	JRC		17 1					
Alternative energy sources, energy saving, substitution	PD	215				545		
Liquefaction and gasification of solid fuels	PD	50				155		
Coal research	ECSC [2]	19	19					

The figures given in the colums show, respectively, the sum allocated to the activity in million ECU and staff, wherever these are mentione in the decision (million ECU/staff)

[1] JRC's staff for the whole programme 2 260 staff members
[2] Annual budget appropriation
SCA Shared-cost action
PD Pilot/demonstration
ECSC European Coal and Steel Community
JRC Joint Research Centre

ogical formations — including under ocean sediments — and evaluation of safety of the different options As for all other Community actions, the work is carried out in a close collaboration with Member States' experts in order to obtain international consensus

The **radioactive waste management programme** is fully complementing the previously mentioned activity It deals with all aspects linked to the fuel cycle installations, e g chemical separation of actinides from medium-level waste, including cost/benefit evaluations Furthermore, it aims at providing the necessary data base and model validation for waste disposal in continental geological formations, and at assessment of safety and feasibility of waste disposal in deep oceanic sediments

The **fissile materials control and management** programme is primarily oriented to assist the Euratom Safeguards Directorate and the European nuclear plant operators in the implementation of their safeguards duties in the frame of the Euratom Treaty and the Non-Proliferation Treaty or other agreements The programme combines the technical requirements originated from the different safeguards obligations with the reality of industrial operations and fissile materials management Harmonization with the Member States are ensured through Esarda (European Safeguards Research and Development Association) and bilateral collaborations The Commission-IAEA (International Atomic Energy Agency) cooperative support programme is an important channel for supporting the IAEA safeguards

The **nuclear fuels and actinide research** programme includes R&D work related to improvement of LMFBR fuels — with emphasis on assessment of optimised advanced fuels, and on study of fuel and fission product behaviour under off-normal conditions Moreover, key problems of the fuel cycle — both LWR and LMFBR — are dealt with such as safety aspects of fuel fabrication with special regard to aerosol formation, and formation of actinides in the reactor In the field of actinide research — where the Commission laboratory plays a leading role in the Community — the main effort is on crystal chemistry and general theory of bonding in solid actinides

The main objective of the **decommissioning of nuclear installations** programme is to develop methods which will ensure the safety and protection of man and the environment against the potential hazards involved in decommissioning operations Accordingly, the programme aims at development of management systems for nuclear installations definitively shut-down, and for radioactive wastes produced in plant dismantling Various decontamination, dismantling and disposal techniques are studied in the light of large-scale decommissioning operations undertaken in the Member States Moreover, the programme aims at identification of guiding principles which could form the initial element of a Community policy in this field

Finally, the **HFR reactor** (high flux reactor) is operated and utilized in support of the research programmes of the Commission and of the Member States, as well as for industry These programmes cover the fields of nuclear fission energy (especially safety aspects), thermonuclear fusion, fundamental research, together with non-nuclear applications in medicine, agriculture (radioisotopes) and in industrial neutron radiography

2. Fusion nuclear energy

Controlled thermonuclear fusion is one of the possible solutions to the problem of energy supply in the long term The scientific and technical problems are so complex, demanding enormous efforts and very long development times, and the potential benefits are so great that the Community countries decided to work together at an early stage Controlled thermonuclear fusion already appeared in the very first programme of the European Atomic Energy Community in 1958 The fusion programme runs for a five-year period After three years of operation a new five-year programme ('rolling programme') is adopted, which thus overlaps with the last two years of the previous programme, thereby ensuring the programme's continuity and consistency The essential features of the European fusion programme are that it is all-encompassing, in that it covers all the activities in all the Member States, and that it has long-term objectives (the prototype reactor) which extend well beyond each five-year programme This approach, which has been extended to include two non-Community countries — Sweden (1976) and Switzerland (1978) — and Spain (1980) has produced major achievements — witness the entry into operation in June 1983 of the JET project (Joint European Torus), inaugurated in spring 1984 at Culham in the United Kingdom

The strategy of the programme is to demonstrate successively

(i) the scientific feasibility of fusion. this is the objective of JET and of the support equipment in national laboratories,

(ii) its technological feasibility for this purpose a NET (Next European Torus) study group has been set up to plan the next step, which will be a high-technology machine,

(iii) its commercial feasibility this will be the objective of a power and demonstration reactor (DEMO) to be built early in the 21st century

The objectives of the programme for 1985-89, adopted by the Council on 12 March 1985 and allocated 690 million ECU, are essentially the exploitation of the JET, the commissioning of new equipment in the national laboratories and establishment of the physics and technological bases for NET

The European fusion programme is carried out under association contracts between Euratom and the national organizations active in this field in the Member States and in Sweden and Switzerland, and the JET Joint Undertaking

A smaller part of the JRC programme is also devoted to fusion In its decision of 22 December 1983 adopting a research programme for 1984-87 to be carried out by the JRC, the Council allocated 46 5 million ECU to fusion technology and safety The Commission has also proposed that the Council use the specific appropriations provided for in the JRC programme for projects of European significance (12 5 million ECU) by applying them to the construction of a tritium-handling laboratory at the Ispra establishment

3. Non-nuclear energy

The European Community launched its first four-year non-nuclear energy R&D programme with an allocation of 59 million ECU in 1975 It gave a new dimension to the JRC's activities and to those carried out under the Commission's aegis and pursuant to the ECSC Treaty to encourage technical and economic research concerning the production and increased expansion of coal A second programme followed in 1979, with 105 million ECU, and a third, with 175 million ECU, was recently adopted by the Council (12 March 1985) [1] In coordination with JRC activities it constitutes the research action programme for non-nuclear energy

[1] Official Journal L 83, 25 3 1985

JRC direct action

The funding allocated for JRC activities is less than that for shared-cost actions These activities have been run for over 10 years by research workers who are Commission staff members and work at the Ispra establishment The activities focus on a limited number of actions and have achieved significant results

In the 1970s research on highly adaptable and clean energy carriers led to the definition and first experimental testing of a thermochemical water breakdown process for producing hydrogen, the aim being to use nuclear heat for this purpose A variant of the same thermochemical process was then developed for desulphurizing the emission gases from thermal power stations, an invitation to tender for an industrial prototype has been issued by the Commission

In the field of solar energy the JRC's task is to contribute to the definition and harmonization of methods and standards One of the largest testing stations in Europe was installed in Ispra in 1977 to test photovoltaic converters and heat collectors Solar-light simulators and equipment to determine aging, mechanical resistance, compatibility, reliability, etc are operational and are used for qualification tests Standardization recommendations have been published, the experience acquired has enabled the JRC to play a significant role, fulfilling its function in this field at European and international level Another specific task of the JRC is to collect and process operational data on projects financed by the Commission

The current programme, adopted by the Council on 22 December 1983 for the period 1984-87, allocates 22 million ECU to solar energy systems testing methods (photovoltaic systems, heat conversion) and 17 million ECU to habitat energy management (assessment of hybrid systems, passive technologies, energy auditing)

Shared-cost projects

ECSC research

Community coal research under article 55 of the ECSC Treaty can now boast a 30-year history, the most recent medium-term guidelines having been established for the period 1986-90 The purpose of the aids granted is to cover direct expenditure on research either in mining technology or in coal derivatives Over the last five years about 90 million ECU will have been contributed for 232 projects submitted by most of the Community member

countries A sum of 19 million ECU is entered in the ECSC budget for 1985

Non-nuclear energy R&D
For the third non-nuclear energy R&D programme (1985-88), adopted on 12 March 1985, the estimated cost is 175 million ECU, it covers nine subprogrammes under two main heads

Development of renewable energy sources

1 Solar energy
2. Energy from biomass
3 Wind energy
4 Geothermal energy

Rational use of energy

5 Energy conservation
6 Use of solid fuels
7 Production and use of new energy carriers
8 Optimization of the production and use of hydrocarbons
9 Analysis of energy systems and modelling

(a) **Development of renewable energy sources**
The first energy R&D programme, covering solar energy, geothermal energy and the production and use of hydrogen, supported 512 projects to a total amount of 43 7 million ECU, and the second programme has assisted 722 projects at a cost of 72 million ECU Under the third R&D programme, a total of 94 5 million ECU will be allocated for solar energy (35 5 million ECU), energy from biomass (20 million ECU), wind energy (18 million ECU) and geothermal energy (21 million ECU)

(b) **Rational use of energy**
Community research in energy conservation was launched with the first non-nuclear energy programme for 1975-79, under which 11 4 million ECU was earmarked to support 117 projects The extension of the R&D programme to the period 1979-83 gave real substance to Community action in this field The number of R&D projects rose to 165 and total aid granted was increased to 27 million ECU

For the period 1985-88 the estimated cost of the R&D subprogramme on energy conservation is put at 26 5 million ECU

The research on solid fuels (coal, lignite and peat, 20 million ECU), new energy carriers (10 million ECU) and hydrocarbons (15 million ECU) are new subprogrammes In some of the sectors they cover, the first two fields supplement and amplify research under the ECSC Treaty

The subprogramme on the production and use of hydrogen carried out from 1975 to 1983 has come to an end, but the results obtained will be of considerable value in launching the new subprogramme on new energy carriers

Finally, part of the resources for the three non-nuclear energy R&D programmes are applied to systems analysis and energy models Under the first two programmes, 144 projects were financed to a total amount of about 10 million ECU The new programme is allocated 9 million ECU Under the programme energy supply and demand models have been developed and set up in all Member States, involving research institutes and university centres These models have also enabled the Commission departments to carry out a study on energy trends to the year 2000 entitled 'Energy 2000' (see *Energy in Europe* No 1, pages 19-24) This study is the reference scenario for the debate on the Community's new energy objectives and is the technical framework for their quantitative elements (see this issue of *Energy in Europe*, pages 8—10)

4. Administrative aspects

- To enable public and private national research institutes to participate in Community shared-cost research programmes, the Commission periodically publishes invitations to submit proposals in the *Official Journal of the European Communities* Proposals must be sent on the appropriate forms to the Commission of the European Communities, Directorate-General for Science, Research and Development, rue de la Loi 200, 1049 Brussels, Belgium

- For its European science and technology strategy the Commission is assisted by several advisory bodies (see box)

- The Commission has started calling in external experts to make a systematic assessment of the operation and results of certain selected programmes, including the non-nuclear energy programmes In January 1983 the Commission presented a Community action plan for the

assessment of the results of research and development programmes of the Eureopan Community, which should be of use in the launching and periodical review of the outline programme of Community scientific and technical activities

● Every year the Commission publishes 60 volumes containing the detailed results of contract research, so far, more than 20 000 publications have been issued Abstracts of reports on research results are published in a monthly series and the full texts are also available on microfilm

● No periodic invitation to submit project proposals is published in the case of the ECSC coal research programme, but applications may be made before 1 September each year for support from the following year's budget and Official Journal C 159, 24 6 1982 contains a communication explaining the application procedure Guidelines for the programme are published from time to time, the most recent, covering the period 1986-90, appearing in Official Journal C 165, 4 7 1985

For the management of the programme, the Commission calls on the services of the Coal Research Committee (CRC) comprising representatives of the coal producers and the associated trade unions, and the Community's principal coal research institutions, who are appointed to the CRC in a personal capacity (Under the terms of the Treaty the Commission must also seek the advice of the ECSC Consultative Committee and obtain the assent of the Council of Ministers for its annual selection of projects The latter represents the only intervention in the programme at national government level) The Commission also has at its disposal a series of comittees of experts, research institutes, universities, and the coal producers whose tasks are to give technical evaluations of new research proposals and to monitor ongoing projects A rapid dissemination of research results to the interested parties in the Community is assured through these committees, as well as through a series of round-table meetings and international symposia Final reports on completed projects are published by the Commission and summaries of these, together with short annual reports and details of new projects, appear in the publication 'Euroabstracts, Section II'

Community consultative bodies

1. **Codest:** Committee for the European Development of Science and Technology, comprising 21 leading scientists (Nobel prizewinners and scientific advisers) appointed by the Commission in their personal capacity to advise on the planning of the common R&D strategy and the implementation of activities to stimulate S/T potential in the Community **The chairman is Professor U. Colombo (President of the ENEA).**

2. **Irdac:** Industrial Research and Development Advisory Committee, comprising 12 members with long experience at a very senior level in R&D work in large industrial firms and 4 members from the European organizations in this field (Unice, ECPE, Feicro, ETUC) All these members are appointed by the Commission in their personal capacity to advise in the preparation and implementation of Community policy for industrial R&D. **The chairman is Dr Beckers (Research Coordination, Shell).**

3. **Crest:** Scientific and Technical Research Committee, whose 22 members are top national and Community officials for science and technology policies, appointed by the governments and the Commission to advise the Commission and the Council in the preparation and implementation of Community S/T policy and the coordination of national S/T policies **The chairman is Professor P. Fasella (Director-General of DG XII).**

4. **CGC:** Management and Coordination Consultative Committees, each with 23 members designated by the Member States and appointed by the Commission There are 12 CGC for the main sectors of activity, their task is to assist the Commission in the preparation and implementation of Community R&D activities and to coordinate national R&D activities in their sectors.

Energy and the environment

Taking the environment into account in energy policy

Just as using energy affects the environment, measures to protect the environment have an impact on the cost of energy supplies and on competition between energy sources Energy and the environment are therefore very closely connected with one another and policy in these two areas should take this interrelationship into account from the outset

The requirement to take the environment into account in energy policy may appear self-evident, but it took rather a long time for the Community and the Member States to translate this into clear energy Community policy obligations After the meeting of European Heads of State or Government in Paris in October 1972, when the need for a Community environment policy was acknowledged and the Commission was urged to submit an action programme on the environment, over 10 years elapsed before the Commission — in the third Community action programme on the environment adopted by the Council[1] — stated that *environmental concerns should be taken into* account in the planning and implementation of all other sectoral policies, including energy policy

This does not mean, however, that in the thirteen years of existence of a Community environment policy environmental aspects have been neglected by those responsible for energy policy Way back in March 1975 the Council of Ministers adopted a resolution on energy and the environment which called for the integration of environment policy and energy policy

'The Council of the European Communities affirms that the maintenance of a sufficient level of energy production and the need to protect the environment must be reconciled with the concern for bettering our society and the quality of life, and that a fair balance should be struck between these two requirements '

Moreover, prior to the adoption of the third action programme on the environment numerous pieces of Community legislation had been adopted to limit the unfavourable effects of energy use on the environment, e g the directive on the lead content of petrol and the directive on the sulphur content of certain oil products

On 22 May 1985 the Commission translated the obligation set out in the third action programme on the environment into Community energy policy. The new energy policy objectives for the Community submitted to the Council (COM(85) 245) state that one of the objectives of Community energy policy is the balanced pursuit of energy and environmental goals The Community energy objectives adopted by the Council in 1974 and 1980 have over the last 10 years been the cornerstone of a consistent and coordinated energy policy in the Community They give expression to agreement on the energy policy priorities and indicate the direction to be taken by the policies of the Member States and the Community (See other article in present edition)

[1] Official Journal C 46 17 2 1983, p 1

Translating environmental protection requirements into Community energy policy

If accepted by the Council, the integration of environmental requirements into Community energy policy cannot mean that environmental protection will become the only determining factor where energy policy is concerned. Nevertheless, it is an indication that environmental considerations would be taken into account in energy policy decision-making How can environmental requirements be translated into practical energy policy?

First of all, it should be pointed out that there are energy policy objectives which have an exclusively beneficial impact on the environment For example, it was acknowledged at international level at the multilateral environmental conference in Munich in 1984 that methods for the rational use of energy resources and for energy conservation constitute a substantial contribution to the reduction of air pollution Action should therefore be stepped up to promote efficient energy use where this is economically possible, either by means of direct incentives, or through suitable pricing mechanisms or by using the best available and cheapest control technologies The Commission emphasized this in the new energy policy objectives submitted by it, and called for a further improvement in energy efficiency in all sectors with a view to reducing overall energy intensity by at least 25%

In addition, it is recongized worldwide that the use and development of improved, cheaper technologies will make a contribution towards resolving environmental protection problems New technologies will not only be an important factor in the necessary process of restructuring the energy economy but also promote energy efficiency and hence environmental protection, and give rise

to production processes which cause little or no pollution and more effective emission reductions The continued promotion of innovative energy technologies through research, development and demonstration is therefore of particular importance and is also included in the catalogue of new energy policy goals for the Community

Greater use of natural gas, combined with limits on nitrogen oxide emissions, the further development of safe nuclear energy generation, non-polluting coal use, greater use of alternative energy resources and the promotion of combined heat and power generation and further quality standards for fuels may make substantial contributions towards reducing emissions and further the attainment of the Community's energy policy and environment policy objectives

There may of course be different emphasis between energy objectives and environmental objectives In order to achieve an acceptable balance when weighing up the relevant factors, it is necessary to examine analytically the economic impacts of proposed decisions This is particularly difficult where the environment is concerned, as it will often be hard to prove that short-term costs are justified by environmental improvements which can only be achieved in the long term However, these difficulties are no justification for failing to make such cost-benefit analyses or to evaluate the relevant scientific evidence

Action to reduce air pollution

Environmental problems cover the whole spectrum of activities of individuals and industries However, where energy conversion and use are concerned, the priority is to prevent and combat air pollution The phenomena of acid rain and forest die-back in parts of the Community have elevated action to combat air pollution to a political priority in the Community

The impetus for recent Community initiatives in this area derived from the European Council in Stuttgart in June 1983 which emphasized the need to combat environmental pollution rapidly and vigorously at national and Community level Special reference was made to the threat to European woodlands, and the Commission was urged to submit proposals to the Council of Ministers for achieving swift and significant progress

The first successful move was the Council Directive of 28 June 1984 on the combating of air pollution from industrial plants which provides for the introduction of authorization procedures for the construction, operation and alteration of such plants on the basis of the best available technologies to reduce or prevent air pollution

The Council can also, acting on a proposal from the Commission, if necessary set uniform Community emission values based on the best available control technology not entailing excessive costs

In connection with this general framework directive, the Commission submitted to the Council in December 1983 the proposal for a Council directive on the limitation of emissions of pollutants into the air from large combustion plants which provides for the setting of compulsory Community emission limit values for sulphur dioxide, nitrogen oxides and dust for new large combustion plants whose rated thermal output exceeds 50 MW In addition, the Member States will be required to draw up national programmes to reduce sulphur dioxide emissions by 60% and emissions of nitrogen oxides and dust by 40% by 31 December 1995 This proposal for a directive, which was slightly amended by the Commission in February at the suggestion of the European Parliament, is at present still being discussed by the Council of Ministers Although the European Council meeting in March called for rapid progress on this proposal, it is unlikely that the discussions can be successfully concluded in the near future The differences between the Member States are too great and fundamental For example, some Member States are questioning the need for Community emission limit values for new large combustion plants and it has been asserted that the Commission proposal does not take sufficient account of the various national situations with regard to industrial development and emission levels In this regard, at Helsinki on 9 July 1985 at the European Commission for Europe's executive body for the Convention of long-range transboundary air pollution 21 countries including Belgium, Denmark, France, FR of Germany, Italy, Luxembourg and the Netherlands signed a protocol to the 1979 Convention on long-range transboundary air pollution to reduce their national annual sulphur emissions or their transboundary fluxes by at least 30% as soon as possible and at the latest by 1993, using 1980 levels as the basis for calculation of the reductions

Apart from large combustion plants, the other Community measures to reduce air pollution are focused above all on motor vehicles with internal combustion engines On 20 and 21 March the Council of Ministers adopted a directive on the approximation of the laws of the Member States concerning the lead content of petrol which

makes it compulsory to introduce lead-free petrol in the Community by 1 October 1989 This directive is intended to ensure that the amount of lead in the air is reduced and that a suitable unleaded fuel is available so that catalytic converters can be used

As regards reducing motor vehicle emissions, Community legislation focuses on three substances carbon monoxide (CO), unburned hydrocarbons (HC) and nitrogen oxides (NO_x) Emission limit values for these substances have been tightened up since 1970 in four successive directives The Council is at present discussing further amendments to Directive 70/20/EEC proposed by the Commission with the aim of tightening up the limit value for motor vehicle exhaust gases and hence reducing air pollution Detailed emission limit values for the various motor vehicle categories were proposed by the Commission in June with a view to reducing emissions of nitrogen oxides, the most dangerous pollutants, by some 50% from 3 million tonnes to 1 5 million tonnes The proposed limit values are as follows

Vehicle category	Time of introduction (new models/new vehicles)	Emission limit values		
		CO	HC + NO_x	NO_x
over 2 litres	1 10 1988/1 10 1989	25	6 5	3 5
1 4 to 2 litres	1 10 1991/1 10 1993	30	8	4
below 1 4 litres	1 10 1990/1 10 1991	45	15	6

These proposals are line with the agreement reached in the Council of Ministers on 20 March whereby the new limit values should be equivalent to the corresponding US standards and should be achievable in the 1 4 to 2 litre category by various technical means at a reasonable cost The Environment Council which met on 27 June led to widespread agreement on these proposals except for one important category For medium size models (1 4 to 2 litres) the NO_x limit was not retained separately but was included *in a combined value* this flexibility ought to allow the development of the 'lean burn' engine

Energy cooperation with China

The fast-growing cooperation between the European Community and China in the energy field was illustrated by the visit to the Community in June of a delegation from the People's Republic, led by Vice-President Yang Jun of the State Science and Technology Commission

China is of course already a major factor in the world energy scene and will become increasingly important in terms of both energy demand and supply At present, Chinese 'commercial' energy consumption is equivalent to about 650 million tonnes of coal a year In addition, there is major use of renewable energy sources China's coal production, at about 480 million tonnes a year, is more than twice as large as production in the Community and supplies over 70% of the country's commercial energy needs Oil production is running at over 100 million tonnes a year and there is considerable activity in offshore oil and gas exploration

The European Community's energy cooperation with China began in 1981 as a result of a visit to China during that year by Michel Carpentier, then Deputy Director-General for Energy in the Commission During that visit, agreement was reached on an energy planning cooperation programme which included the training of Chinese officials in energy planning techniques, both in China and in Europe, and studies of industrial and rural energy demand in that country The cooperation programme later expanded into other fields such as coal mining, electricity production and transmission, and energy conservation

One major feature of the programme is that more than 1 500 Chinese nationals have been trained

(i) in four EC-China energy planning and management training centers in Peking, Tianjing, Nanjing and Hangzhou, with the assistance of more than 50 European experts,

(ii) in Europe at technical and university institutes in Belgium, France, Germany, Italy, Netherlands and the United Kingdom

The graduates of these training activities have gone on to draw up local and regional energy balances, to establish energy plans in various Chinese cities and districts and to provide energy management services for different branches of Chinese industry

Another important cooperation activity has been the joint development of energy analysis instruments involving a team of 10 energy researchers at Tsinghua-University in Peking (Institute of Nuclear Energy Technology) INET is a member of the EC-financed international network of energy institutes in developing countries The methods developed are now used in China for evaluating energy demand and supply and for resource assessments

The Commission has provided funding for these activities up to the level of 50% of total costs By end 1984 some 3 million ECU had been committed to this programme. The 1985 programme includes some 12 projects in the areas mentioned above

The visit in June was made at the invitation of the Commission and focused both on energy and on information technology In Brussels Mr Yang Jun and his team met with three Members of the Commission — Nicolas Mosar (Energy), Karl-Heinz Narjes (Industry and Research) and Willy De Clercq (External Relations) — as well as holding discussions with the Commission services responsible for these fields They also met with government authorities and industries in Belgium, France Netherlands, Denmark and Germany

In the energy field, a joint memorandum was signed at the end of the visit recording agreement in principle on new areas for EC-China energy cooperation, specifically

(i) The opening of an EC-China training centre on coal combustion technology at Harbin in the North of China

(ii) The inclusion of a second Chinese energy research institute in the EC-network on energy planning in developing countries

(iii) Cooperation in a second energy management training centre in Nanjing, to build on the results obtained in this field at the first centre in Nanjing and the centre in Hangzhou

(iv) Cooperation in the installation of software for electric power system planning

(v) Exchanges of staff

(vi) Production of video-tapes on EC-China energy planning cooperation projects

(vii) Studies of a decentralised energy system using in particular new and renewable energy sources (solar energy centre on Dachen Island, Zheijiang Province)

This visit was the second high-level mission to Europe of its type following an energy mission led by Vice-President Yang Jun in February 1982 It gave both parties the opportunity to underline the importance of cooperation between the People's Republic of China and the European Community and to express their satisfaction with the results achieved in the energy field.

Energy markets in the European Community – Short-term outlook 1985-86

The Community's consumption of primary energy is expected to increase by 2.6% in 1985 and 2.9% in 1986. The four main reasons for this are the expected increases in the Community's GDP (2.3% for which both years), 3—4% growth rates of industrial production, weaker energy prices (led by lower oil prices) and cold weather in the early part of 1985. The base case forecast also assumes some ECU revaluation against the dollar which, if correct will accelerate the fall in real energy prices. Following the ending of the United Kingdom mining strike in early 1985, coal consumption could by 3% higher this year than in 1984, but oil consumption is forecast to fall by 2-3% in 1985 but perhaps increase very slightly in 1986. Gas and electricity consumption should increase in both years and at similar rates, but the most telling factor in the period will be the increase in nuclear power. In 1986 nuclear should provide nearly 15% of the Community's energy needs, as against only 4% in 1980. The Community's net energy import dependence is expected to fall to 42% in 1986, as compared to 44% last year.

Highlights

(i) The Community's **energy consumption** grew by 3.6% in 1984 — the highest rate of growth since 1979. This was due to the European economies moving out of recession, particularly a pick up in the output of the energy intensive industries, and more stable (rather than rising) real energy prices. Primary energy consumption in the Community is expected to continue increasing in 1985 and 1986, but at the slower rates of 2.6% and 2.9% respectively. The driving variables for this growth in energy consumption are Community GDP (forecast to increase by 2.3% in both years) and industrial production predicted to increase by at least 1% more than GDP. Also energy prices are expected to be weaker over the forecast period. Colder weather also played a part in early 1985.

(ii) **Oil demand** increased by 2.8% in 1984 because of the increase in fuel oil consumption in the United Kingdom during the coal strike. Discounting this factor, Community oil demand would have fallen by about 1%. In 1985 oil demand could fall by 3% and possibly increase by 1% in 1986.

(iii) **Electricity demand** will be determined by expected constant electricity prices in real terms and by rising GDP. Demand is expected to increase by 4.5% in 1985 and 2.5% in 1986. Nuclear could supply 34% of the Community's electricity production in 1986.

(iv) The Community's **natural gas demand** expanded by 6% in 1984. Further increases of 3.9% and 3.0% are expected in 1985 and 1986 respectively. There is still uncertainty surrounding these projections because of the difficulty in predicting the evolution of natural gas prices in the short term. Even though some of the Community's gas suppliers have reduced their prices (by up to 10% in some cases) the competitive position of natural gas in 1985 and 1986 could still be disadvantaged by the fact that the link between its prices and those of oil products (mainly fuel oil and more recently gasoil) involves a time lag.

(v) The ending of the UK mining dispute in March 1985 has improved the short-term prospects for coal. **Solid fuel demand** fell by 5% in 1984. It is expected to increase in 1985 — but only by 3%. Overall, three important factors will tend to restrain coal consumption: the increase in nuclear capacity, rebuilding of power station stocks and potential environmental constraints.

(vi) **On the supply side** — two factors stand out. **Firstly** the surge in nuclear production — by 1986 nuclear output will be the equivalent of nearly 15% of the Community's primary energy consumption. **Secondly** that in 1985 the Community's oil production is expected to peak. Community coal production will recover in 1985 but will probably not reach the pre-strike 1983 output level. A further increase in production is expected in 1986. The Community's net energy import requirement will remain at around 400 Mtoe through the forecast period. Overall net import dependence will be 42% in 1986 (from 44% in 1984).

Comparison with previous forecasts

The table below compares the 1985 forecasts of the Community's energy consumption that have appeared in each edition of *Energy in Europe* published so far.

1985 Estimated gross inland consumption			(million toe)
	Energy in Europe NO 0 (December 1984)	Energy in Europe NO 1 (April 1985)	Energy in Europe NO 2 (August 1985)
Solid fuels	205 3	201 0	204 5
Oil	426 5	421 7	415 6
Natural gas	176 8	183 6	182 3
Nuclear	117 4	116 4	120 1
Hydro	12 7	12 7	12 6
Net imports electricity	1 7	0 9	1 7
Total	940 4	936 4	936 7

In *Energy in Europe* No O it was assumed that the UK mining dispute would end on 31 December 1984 and hence solid fuel demand was forecast to be higher than in the latest estimates Oil demand has also been 'marked down' slightly over time in part due to a more rapid backing out of fuel oil in power stations By contrast projected 1985 natural gas consumption has edged upwards — to a large extent because of gas suppliers reducing their prices However there is still some uncertainty regarding the natural gas outlook Finally nuclear production is expected to be slightly higher than forecast in *Energy in Europe No 0* Several nuclear reactors will be coming on stream earlier than expected Overall energy demand however has remained more or less unchanged

The remainder of this article presents the Commission's Directorate General for Energy's (DG XVII) latest Community energy forecast covering the period 1985 and 1986 The results are mainly derived from a short-term forecast model — codenamed STEM — that has been jointly developed by DG XVII and DG XII (the Directorate General for Science, Research and Development) A series of key assumptions underly all the results Some alternative scenarios are however presented to test the sensitivity of the main results to different assumptions

1. Forecasting assumptions

(1) Macroeconomic climate

The macroeconomic assumptions used for this forecast are derived from the Commission's Directorate-General for Economic and Financial Affairs (DG II) [1]

Community GDP is forecast to grow by 2 3% by both 1985 and 1986

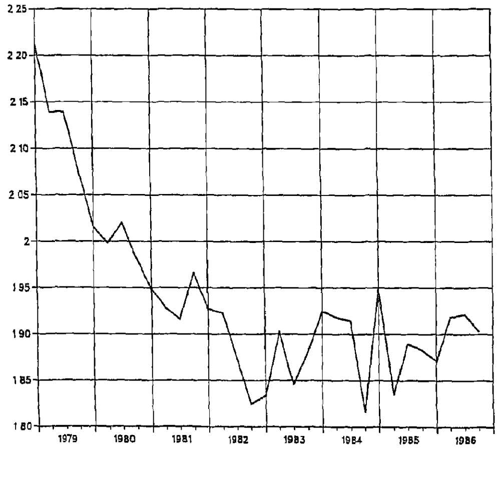
The ending of the UK mining dispute will boost the 1985 rate of economic growth Leaving this factor aside, the underlying trend in 1986 is in fact higher than in 1985

The expected quarter on quarter changes show low growth in Q1 1985 (+ 0 4% over previous quarter at annual rate), an acceleration in Q2 1985 to 4 8% annual rate before slowing to around 2 2% from Q3 85 to Q3 86 A pick up at the end of Q4 1986 to 2 7% is expected

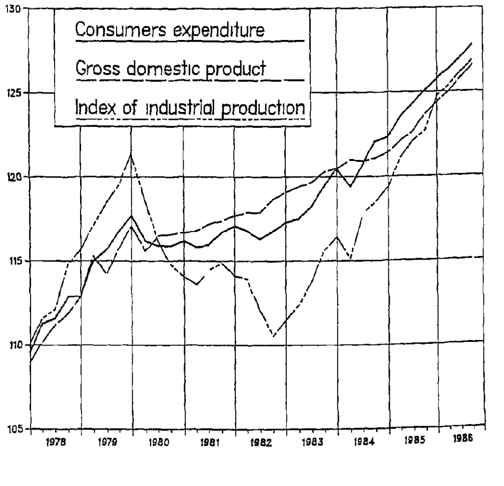
In both 1985 and 1986 the main contribution to these projected changes in Community GDP are derived from domestic demand The following table summarizes the macroeconomic forecast

[1] Economic forecasts 1985-86 Detailed tables May/June 1985

Graph 1 — EUR 10 Quarterly energy ratio trend (volume of seasonally adjusted inland energy consumption/ real GDP index



Graph 2 — EUR 10 Quarterly macroeconomic indicators (1975 = 100)



Community demand components — % change on preceding year

	1984	1985	1986
ivate consumption	1 0	1 5	2 3
overnment consumption	1 2	1 6	0 9
ross fixed capital formation	2 3	2 2	2 9
of which construction	1 4	- 1 4	1 0
equipment	3 4	6 1	4 7
iange in stocks	1 5	1 7	1 7
omestic demand	2 0	1 9	2 2
of which (contribution to change in GDP)	1 3	1 6	2 7
DP	2 1	2 3	2 3

idustrial production is forecast to increase by 4% in 985 and by 3 2% in 1986 — particularly affected by the trong increases expected in equipment investment and uoyant export demand

'he Community's inflation rate is forecast to fall from round 6% in 1984 to 5 5% in 1985 and 4 7% in 1986

lecause most imported energy is priced in US dollars, one of the most important assumptions for the forecast conerns the **ECU/USD exchange rate.** The base case asumption is that the ECU will continue to slowly revalue igainst the dollar so that its average value in 1986 will be equal to its average 1984 value

ii) **Community crude oil production**
This is forecast, exogenously, to be about 146 million toe n 1985, slightly higher than in 1984 UK North Sea oil and condensate production are expected to reach their peak levels in the first half of 1985

(iii) **Nuclear capacity**
The recent surge of new nuclear capacity coming on stream in France, Germany and Belgium is having a significant effect on the Community's energy economy Average capacity in 1985 (about 63 GW) will be 24% higher than in 1984 A further significant increase is expected in 1986 By the end of Q4 1986 — Community nuclear capacity could stand at 80 GW

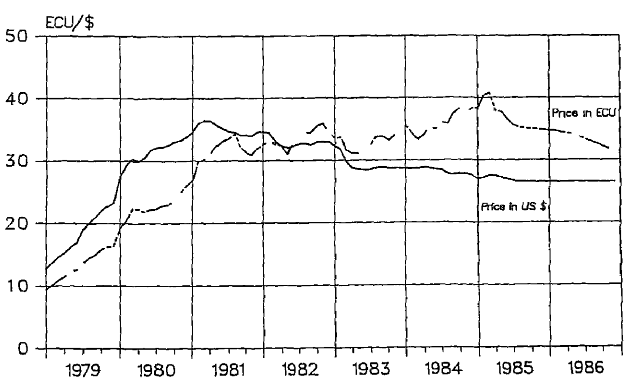
(iv) **Temperature**
Average weighted degree days in the Community were 20% higher in Q1 1985 compared to the corresponding period of 1984, thereby increasing energy consumption (mainly natural gas, electricity and domestic heating oils) For the remainder of the forecast period average degree days over the past eight years are assumed

2. Energy prices

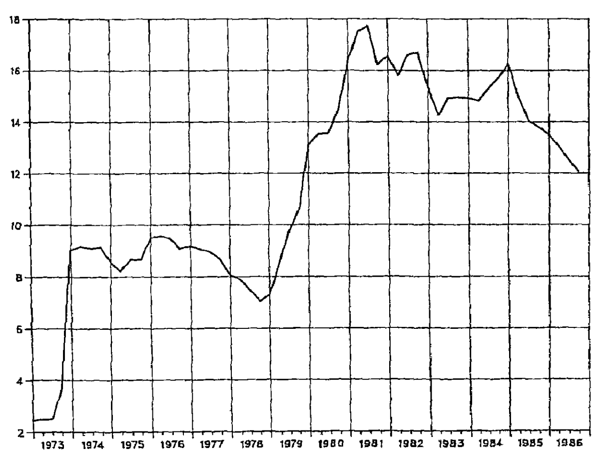
(i) **Crude oil prices**
In view of continuing market pressures, the average dollar cost of crude oil to the European Community, which has declined by more than USD 1 20 per barrel between the first quarter of 1984 and the second quarter of 1985, is assumed to slide further to around USD 26 50 by the third quarter of 1985, and to remain at that level until the end of 1986

The continuing weakness of the world crude price is certainly not a new phenomenon but until recently it has failed to be translated into lower prices paid by the Community countries because of the rapid and prolonged

Graph 3 – EUR 10 Average crude oil import price / barrel(FOB)



Graph 4 – EUR 10 Real price of imported crude oil/barrel(FOB) – ECU(1975)



appreciation of the dollar against European currencies In fact, measured in ECU terms, the average cost of crude to the Community reached an all time peak at just under 41 ECU per barrel in March 1985 (compared with around 31 ECU in May 1983) The recent rise in the value of the ECU has however meant that oil costs to the Community have fallen by more than 4 ECU per barrel between March and June 1985 The continued modest appreciation of the ECU incorporated in the present forecast, together with the weakness of the world crude price, is assumed to result in the Community paying, just over 34 ECU/barrel by the end of 1985 and less than 32 ECU/ barrel by the end fo 1986

Cautious as these oil price and exchange rate assumptions may be, they do point to some striking consequences Real (deflated) crude oil prices in ECU terms would not only register their first significant and sustained fall for the Community since the 1979-81 price 'shock', but would fall back to their end-1979 level by the end of 1986

(ii) Oil product prices

The first quarter of 1985 was marked by unusual firmness of heavy fuel oil and gas oil prices which had then gained approximately 55 ECU per tonne and 60 ECU per 1 000 litres respectively over their levels of a year ago These gains were much larger than those registered by crude oil prices and can be attributed to relative scarcity of these products at the beginning of 1985 In the case of gasoil this was due to excess demand and low stocks resulting from harsh weather conditions throughout Europe in January and February Heavy fuel oil prices were also influenced by weather related demand but the firmness can be primarily attributed to excess demand arising from the effects of the UK coal miners strike Already by the second quarter of 1985 heavy fuel oil prices had lost on average around 35 ECU per tonne following the end of the strike, and are expected to continue falling more moderately throughout the forecast period in the wake of falling oil prices and weak demand until they stabilise at around 200 ECU per tonne by the end of 1986 Heating gas oil prices also registered a fall in the second quarter of 1985, and are expected to fall further and more sharply in the third quarter, before starting a slight recovery

Having peaked in the second quarter of 1985, final prices (inclusive of taxes) of motor spirit and diesel are expected to decline very moderately to the end of 1985 and thereafter remain reasonably stable In real terms all petroleum product prices are expected to be lower by the end of the forecast period than they are at present However their average levels in 1986 will be close to the 1984 averages, with the notable exception of heavy fuel oil which will be markedly lower

(iii) Natural gas prices

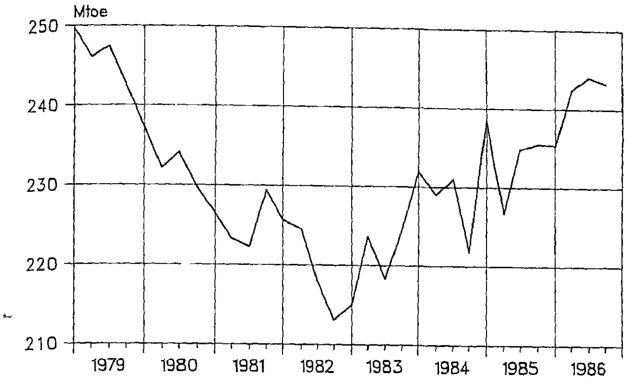
As indicated in the April issue of *Energy in Europe* average imported natural gas prices into the Community escalated throughout 1984 trailing the substantial increases in the price of heavy fuel oil It has been becoming evident in recent months that further escalation would be inevitable under present price formulae In anticipation of this a number of events have taken place to smooth the impact These involved the re-negotiation of some contracts to (a) lower the base price, (b) reduce the weigth of heavy fuel oil in the indexing formulae whilst increasing that of gas oil, (c) denomination of contracts in ECU or importing country currencies Although these measures would have stalled or drastically moderated the imported gas price escalation in 1984, had they been applied a year earlier it is doubtful whether under present conditions they can prevent further significant increases in the rest of 1985 The ECU or local currency denomination would have trimmed increases in the context of a rising dollar but may work in reverse in the circumstances of a weakening dollar Furthermore the increase of the weight of gas oil prices in the indexing formulae will, in the short term, increase prices since gas oil registered the biggest price increases during the first quarter of 1985 In this way the lowering of the base price is likely to provide only a temporary respite (an 8% downward adjustment was incorporated in the base case forecast) and imported natural gas prices are expected to increase strongly during the rest of the year Thereafter the indexing formulae will start reflecting the recent petroleum product price falls and gas prices at the frontier could fall throughout 1986

These movements in gas prices are likely to have impor tant implications for the competitiveness of natural gas in what is arguably the only energy market with significan short-term interfuel substitution potential dual (oil/gas fired industrial boilers There, natural gas has been slow ly building a strong competitive edge over heavy fuel o since mid-1982 These gains may, however, be complet ly eroded in the brief period to the autumn of 1985 I addition, not even a partial recovery of competitivity is t be expected before the end of 1986 Even when natur gas prices eventually start falling they will still be laggi behind the continuously decreasing heavy fuel oil price

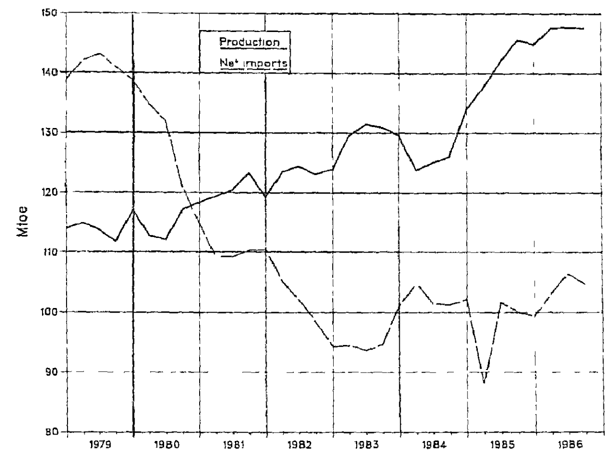
(iv) Coal prices

Reduced imports of steam coal following the resumpti of UK coal production together with a falling dollar fo

Graph 4 1 – EUR 10 Seasonally adjusted quarterly primary energy consumption



Graph 5 – EUR 10 Seasonally adjusted quarterly primary energy supply



the background for imported steam coal price weakness which should begin to be felt after the third quarter of 1985 As imports of hard coal are forecast to fall further in 1986, weak demand will result in a continuation of this price trend into that year

Coking coal prices are also expected to register further losses, especially in 1986 following prolonged stagnation of demand for steel making

Real coal prices to industry in 1986 will be lower than they have been at any time since 1979

3. Overall energy

Overall energy demand increased by about 3 6% in 1984 and this growth in demand continued into the first quarter of 1985 when energy demand was 2 9% higher than the corresponding period of 1984 Very cold weather throughout Europe was probably the dominant factor Energy demand is forecast to continue growing in 1985 at a slow rate The driving variables will be the assumed 2 3% GDP and 4% industrial production growth and weaker energy prices (particularly for the 'lead' fuel namely oil) The expected quarter on quarter changes are as follows

	Overall increase in energy demand (over same quarter of previous year)	Increase in primary energy consumption
Q1 85/4	+ 2 9%	+ 5 5 Mtoe
Q2 85/4	– 1 1%	– 2 3 Mtoe
Q3 85/4	+ 1 9%	+ 3 7 Mtoe
Q4 85/4	+ 6 0%	+ 14 7 Mtoe

The strong increase expected in Q4 85 can be explained by the unusually mild weather and the slowdown in industrial production in the same quarter of 1984

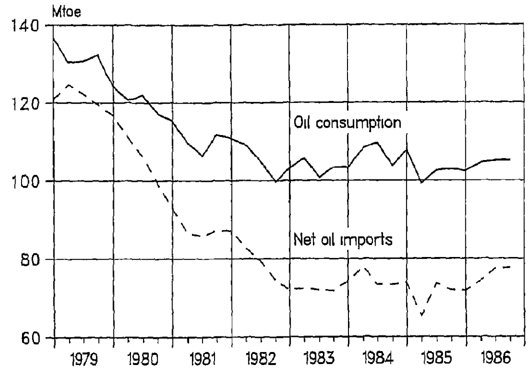
The prospects for 1986 are for a further increase in Community energy consumption Around 2½-3 0% growth is forecast Positive economic trends and the possibility of a fall in real oil prices for the Community support this view

The accompanying graph shows that the Community's primary energy intensity (primary energy consumption/GDP) has flattened since falling to register a trough in Q4 1982 This is not easy to explain — but the upturn in the energy intensive industries on top of the expanding nuclear contribution to primary energy consumption (which in statistical terms inflates primary energy consumption) plus the contribution of economic growth could supply the basis of an answer These trends would be better examined at the level of final energy demand by sector

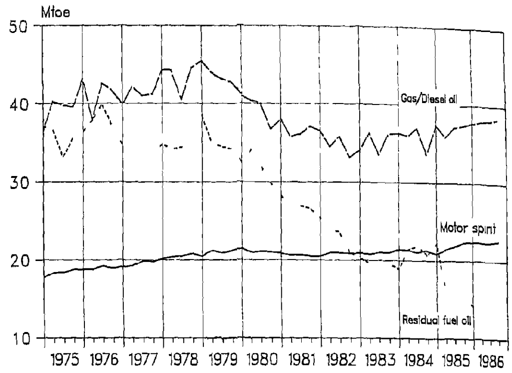
Oil

No increase in oil demand is forecast in 1985 Overall Community oil demand could fall by 2½-3 0% in 1985 with perhaps a small 1% increase in 1986 The trends by product differ considerably Whilst increases in demand are expected for mogas and gas/diesel oil in 1985 — these will be more than offset by a rapid decline in fuel oil use (15% less than in 1984) and lower demand for other petroleum products Overall Community oil

Graph 6 – EUR 10 Seasonally adjusted quarterly oil consumption and net oil imports



Graph 7 – EUR 10 Seasonally adjusted oil products consumption



demand could level at around 415 million toe in 1985 — 22% lower than in 1979

This picture is expected to be broadly similar in 1986 in spite of the large fall in real oil prices which the base case projects The motor fuels are again expected to increase but will be offset by a further decline in fuel oil usage

On the supply side the Community's net import requirement will reamin broadly unchanged throughout the period Community oil production will peak in 1985 but stocks of oil may remain low in line with low demand

Natural gas

1984 saw a strong 6% increase in Community natural gas demand Demand in the first quarter of 1985 was 5% up on Q1 1984 and overall demand is expected to increase by 3 9% in 1985

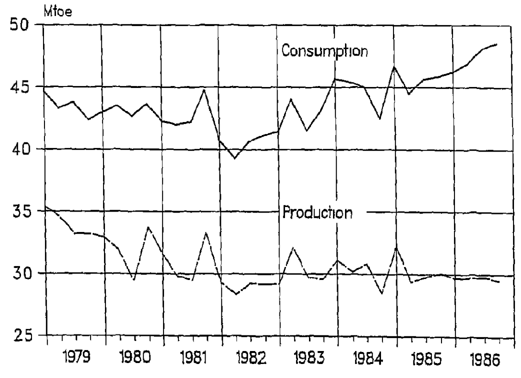
The short term prospects for gas are clearly linked to whether gas producers continue to react to the uncompetitive position of gas (see earlier) An expected slow down in chemical output is also expected to constrain demand In 1986 demand could increase by around 3 0%, although this projection must be regarded as rather uncertain

Net imports of gas are expected to increase from 60 million toe in 1985 to 70 million toe in 1986

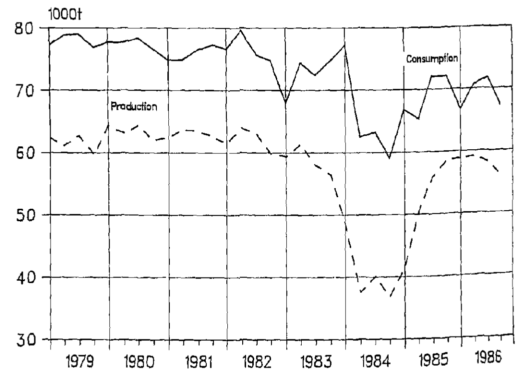
Coal

The ending of the mining dispute at the end of Q1 1985 has improved the short-term prospects for coal Following a 5% fall in solid fuel consumption in 1984, consumption in 1985 is forecast to edge up by 3% The reason for only a modest increase is that because of the continuing strike, hard coal consumption was 11 million

Graph 8 – EUR 10 Seasonally adjusted natural gas supply & demand



Graph 9 – EUR 10 Seasonally adjusted hardcoal consumption and production



tonnes lower in Q1 85 compared to Q1 84, and secondly stocks at power stations in the United Kingdom were very low at the end of March 1985 and could be expected to be substantially rebuilt before the winter months So although hard coal deliveries will increase by 18% — consumption will only increase modestly Graph 9 shows the speed of adjustment of Community coal production. Overall 1985 hard coal production is forecast to be 206 million tonnes

The outlook for coke is rather 'flat' in 1985 No significant increases in Community steel production are expected in the 1985-86 forecast period Coke consumption is therefore expected to remain at close to the 1984 level (48 million tonnes) The Commission has recently published a detailed paper on the market for solid fuels in 1984 and the outlook for 1985 [2]

Electricity

Community electricity consumption increased by 4% in 1984 Every Member State recorded increased demand, with France, Italy, Belgium, Denmark and Greece recording growth above the Community average The strongest component of this demand growth was industrial demand for electricity which surged by 4 6% in 1984, with household demand increasing by 3.7% Community electricity demand continued to increase in the first quarter of 1985 (helped by cold weather) — with demand up by 4 4% over the corresponding period of 1984 Demand growth in the first quarter of 1985 was particularly strong in France, Belgium und Italy Overall electricity demand is forecast to increase by around 4 5% in 1985 — some 2% above the rate of growth of GDP, with the highest quarter on quarter growth being forecast for the last quarter of 1985

As far as the **supply of electricity** is concerned, nuclear production is expected to maintain its strong performance In the first quarter of 1985 alone it increased by 25% over the corresponding period of 1984 Nuclear could cover a little more than 30% of the Community's electricity production in 1985 As for the other fuels, coal burn will increase but will remain well short of its 1983 peak, whilst residual fuel oil consumption in power stations is forecast to be 30% lower than in 1984 Natural gas consumption in power stations could stay at around the 1984 level

The prospects for 1986 are for continued electricity growth — perhaps around 2 1/2% but still above GDP growth Nuclear production will again increase strongly Coal consumption could increase by around 5% in power stations, displacing more fuel oil

Alternative scenarios

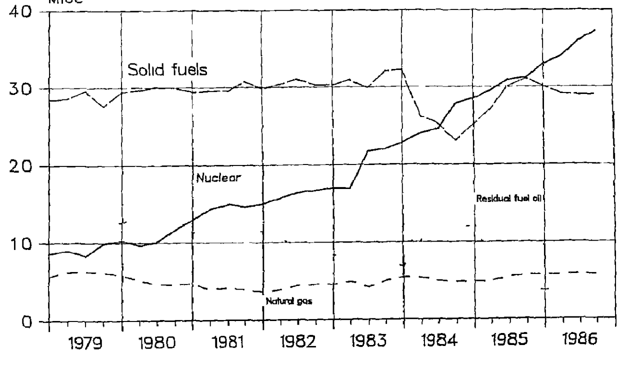
Using the model two alternative scenarios around the base forecast were carried out to test the sensitivity of energy economy variables to changes in the basic assumptions These are as follows

Scenario 1: The 'recession simulation'

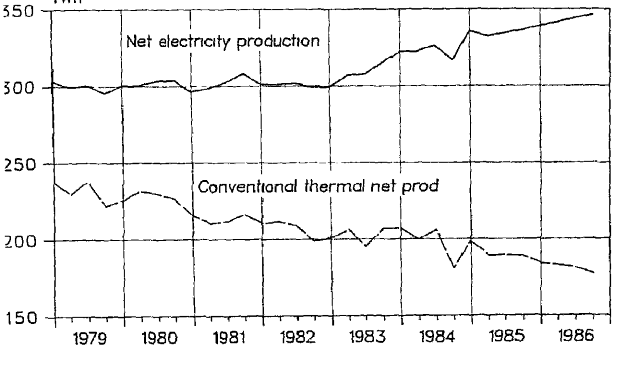
Following a drastic slowdown in world trade in 1985 the European economy is assumed to stagnate for the remainder of the year and only register 1% growth in

[2] The market for solid fuels in the Community in 1984 and the outlook for 1985 Official Journal C 177, 15 7 1985

Graph 10 — EUR 10 Quarterly inputs for electricity generation (seasonally adjusted)



Graph 11 — EUR 10 Seasonally adjusted electricity production



1986. The main results for 1986 on the basis of this simulation are as follows

Impact of 'Recession simulation' — in % deviations from 'base case', 1986

GDP	- 2 9
Energy consumption	- 3 5
Energy intensity	- 0 5
Consumption	
Solid fuels	- 6 2
Oil	- 2 7
Natural gas	- 5 1
Electricity	- 2 6
Deliveries of	
Motor spirit	- 1 0
Gas oil	- 1 7
Heavy fuel oil	- 5 6
Coke	- 12 0
Production of	
Hard coal	- 2 7
Natural gas	- 4 2
Net imports of	
Hard coal	- 13 4
Oil	- 4 8
Natural gas	- 6 0
Prices	
Heavy fuel oil	- 0 7
Industrial gas	- 2 1
Coking coal	- 1 6

The key points to note are the following

(i) Energy consumption in the short-term would be disproportionately affected by the reduced GDP In other words there would be a drop in energy intensity This is primarily due to the exaggerated impact of a recession on some key energy consumption sectors like chemicals and iron and steel and industry in general

(ii) Consumption of gas and solid fuels would be sharply affected in view of their role in the chemicals and iron and steel sectors respectively In the case of solid fuels an important role is also played by the structure of power generation where the diminution of the share of oil has rendered coal into a 'swing' source, given that nuclear and hydro would still be used at or near their practical maxima

(iii) Oil consumption would be less affected because of the shift in recent years of petroleum markets away from the heavy products which are sensitive to the general economic climate, and towards transportation fuels which are less sensitive in this respect

(iv) Net imports of hard coal are particularly heavily affected due to their relatively small magnitude and the relative insensitivity of European production to changes in demand

Scenario 2: 'Oil price cut simulation'

In this simulation an attempt is made to trace thrc time the likely effects on the European energy econom a cut to USD 24/barrel in the world price of oil

The interesting question is how quickly and by much would European energy markets respond to ar mediate price cut? By implication the answer to this c tion (even at only a European level) would give som dication as to the suitability of price cuts as a means c fluencing the present imbalance between supply anc mand for fuels The following tables summarise th sults of the simulation

Phased impact of 'USD 24/barrel from 1 July simulation' in % deviations from base case

	2nd quarter	4th quarter	6th quart
Consumption			
Primary energy	0 4	0 8	1 0
Oil	1 0	1 9	2 3
Coal	- 0 3	- 0 6	- 0 7
Natural gas	0 1	0 5	0 5
Electricity	0 0	0 0	0 1
Deliveries of			
Motor spirit	0 4	0 9	0 5
Gas oil	1 2	2 1	2 6
Heavy fuel	1 3	3 1	4 4
Net import			
Oil	2 0	3 9	4 2
Coal	- 0 8	- 1 6	- 3 8
Approximate oil import bill	- 7 6	- 5 9	- 5 6

Phased impact of 'USD 24/barrel from 1 July simulation'

	2nd quarter	4th quarter	6th quar
Import prices			
Crude	- 9 5	- 9 5	- 9
Natural gas	0 0	- 6 5	- 9
Steam coal	- 3 3	- 6 9	- 6
Coking coal	- 1 2	- 3 0	- 3
Consumer prices.			
Motor spirit	- 2 2	- 2 1	- 2
Diesel oil	- 3 3	- 3 2	- 2
Gas oil	- 6 7	- 6 4	- 5
Heavy fuel	- 7 7	- 7 6	- 7
Natural gas			
Industry	0 0	- 4 2	- 7
Residential	0 0	- 1 8	- 4
Coal (ind)	- 1 5	- 4 3	- 4
Electricity			
Industry	- 0 3	- 1 0	- 1
Residential	- 0 1	- 0 5	- 0

Some points of interest emanating from an examin of the above results are

(i) Petroleum product prices would reflect the full decrease within six months and subsequently rience slight reverse effects due to increasing den

(ii) All other fuel prices would be affected but more slowly, and incur a short-term loss of competitiveness This phenomenon would be short-lived and in the crucial case of industrial natural gas the situation *vis-à-vis* heavy fuel oil would be entirely restored after 18 months

(iii) Though oil would increase its share in total energy demand, lower energy prices in general would also result in higher consumption for other fuels (slightly lower consumption is registered only for hard coal)

(iv) Oil consumption would rise appreciably and, because of the short-term price insensitivity of European crude production, net oil imports would experience an even more marked increase

Table 1 — Primary Energy balance for the European Community

(Mtoe)

	1980	1981	1982	1983	1984	1985 [1]	1986 [2]
Primary production							
Solid fuels	184 8	185 0	182 1	174 0	130 1	157 2	173 8
Oil	91 4	101 6	114 9	131 2	143 2	146 2	142 2
Natural gas	129 4	125 5	116 1	119 9	120 4	122 5	118 6
Nuclear	42 1	56 8	63 9	77 4	99 3	120 1	140 0
Hydro	12 6	12 8	12 6	12 5	12 2	12 6	12 8
Total	460 3	481 7	489 5	514 9	505 1	558.6	587.4
Net imports							
Hard coal	48 2	43 4	45 5	37 6	51 3	45 5	40 5
Oil	433 1	352 5	323 2	287 7	298 4	284 3	300 9
Natural gas	43 5	46 2	45 8	50 1	57 9	60 7	70 9
Electricity	1 2	1 9	1 7	1 9	1 3	1 6	1 7
Total	526 0	444 0	416 1	377 3	408 8	392 1	413 9
Change in stocks							
Hard coal/coke	11 0	8 9	9 7	2 7	– 16 5	– 1 9	11 9
Oil	15 2	– 17 3	– 11 7	– 18 0	– 5 9	– 5 9	0 9
Natural gas	3 9	6 7	3 4	4 9	2 8	0 9	1 8
Bunkers	23 0	25 1	23 4	21 5	20 5	20 9	22.7
Estimated gross inland consumption							
Solid fuels	222 0	219 5	217 9	208 8	197 9	204 5	202 4
Oil	486 4	446 3	426 4	415 4	427 0	415 6	419 5
Natural gas	169 0	164 9	158 5	165 1	175 4	182 3	187 7
Nuclear	42 1	56 8	63 9	77 4	99 3	120 1	140 0
Hydro	12 6	12 8	12 6	12 5	12 2	12 6	12 8
Total	933 2	902 2	880 9	881 1	913 1	936 7	964.0
Net imports as % of consumption [1]							
Hard Coal	21 7	19 8	20 9	18 0	25 9	22 2	20 0
Oil	85 0	74 8	71 9	65 9	66 7	65 1	68 0
Natural gas	25 7	28 0	28 9	30 3	33 0	33 3	37 8
Total	55 0	47 9	46 0	41 8	43 8	40 9	41.9

[1] Net imports/(gross inland consumption + bunkers)

[2] Forecast

Table 2 — Primary energy balance for the European Community

	1984		1985				1986[2]		
	III	IV	I	II [2]	III [2]	IV [2]	I	II	III
Primary production									
Solid fuels	29 6	31 7	35 1	36 8	38 5	46 8	46 9	42 2	39 7
Oil	34 7	37 7	37 9	35 0	35 5	37 9	36 9	34 5	34 9
Natural gas	19 4	32 8	44 7	24 5	18 8	34 6	41 2	24 7	18 8
Nuclear	21 7	28 9	32 3	28 1	27 3	32 4	37 4	32 1	31 8
Hydro	2 8	3 0	3 0	3 5	3 0	3 1	3 2	3 5	3 1
Total	**108 3**	**134 2**	**153 0**	**127 8**	**123 0**	**154 7**	**165 5**	**137 0**	**128 2**
Net imports									
Hard coal	13 5	14 1	12 6	8 2	12 1	12 6	8 9	12 5	11 3
Oil	71 0	76 2	73 7	64 7	71 2	74 8	71 4	73 7	74 9
Natural gas	11 6	15 3	16 1	14 6	12 7	17 3	19 1	16 5	14 4
Electricity	0 5	0 4	0 2	0 5	0 6	0 2	0 2	0 6	0 7
Total	**96 6**	**106 0**	**102 6**	**88 0**	**96 7**	**104 8**	**99 5**	**103 3**	**101 2**
Change in stocks									
Hard coal/coke	1 0	− 3 2	− 8 3	− 0 5	4 8	2 0	0 4	6 6	5 9
Oil	− 2 8	− 2 7	− 7 9	1 2	4 3	− 3 5	− 5 8	3 9	4 5
Natural gas	3 8	− 1 3	− 4 5	3 2	3 8	− 1 6	− 3 3	3 1	3 9
Bunkers	5 3	5 0	4 8	5 0	5 5	5 6	5 5	5 8	5 8
Estimated gross inland consumption									
Solid fuels	42 1	49 1	56 1	45 4	45 7	57 3	55 4	48 2	45 2
Oil	103 2	111 7	114 6	93 5	96 9	110 6	108 6	98 5	99 5
Natural gas	27 2	49 4	65 3	35 9	27 7	53 4	63 6	38 1	29 3
Nuclear	21 7	28 9	32 3	28 1	27 3	32 4	37 4	32 1	31 8
Hydro	2 8	3 0	3 0	3 5	3 0	3 1	3 2	3 5	3 1
Total	**197 6**	**242 4**	**271 4**	**206 9**	**201 3**	**257 1**	**268 2**	**221 0**	**209 4**
Net imports as % of consumption [1]									
Hard coal	32 0	28 8	22 6	18 0	26 4	21 9	16 1	26 0	25 0
Oil	65 4	65 3	61 7	65 6	69 6	64 4	62 6	70 6	71 1
Natural gas	42 7	31 0	24 6	40 7	45 8	32 3	30 0	43 3	49 1
Total	**47 6**	**42 8**	**37 1**	**41 5**	**46 7**	**39 9**	**36 4**	**45 5**	**47 0**

[1] Net imports/(gross inland consumption + bunkers)
[2] Forecast

Table 3 — Hydrocarbons supply and disposal in the European Community

	1979	1980	1981	1982	1983	1984	1985 [3]
1 Oil (Million tonnes)							
Primary production	88 6	90 6	100 7	113 9	130 1	142 0	145 0
Change in stocks [1]	17 7	15 1	− 17 2	− 11 6	− 17 9	− 5 9	− 5 8
Net imports [1]	487 3	433 0	353 0	323 7	288 4	298 9	285 0
Bunkers	27 5	24 5	26 8	25 0	23 0	21 9	22 3
Apparent consumption	**530 8**	**484 0**	**444 1**	**424 3**	**413 3**	**424 9**	**413.5**
Inland deliveries							
Motor spirit	83 9	84 5	82 6	83 3	83 7	85 1	86 6
Gas/diesel oil	175 7	158 6	147 5	140 3	140 4	142 5	148 1
Heavy fuel oil	142 8	128 0	108 1	93 6	77 8	82 5	69 7
Other production	96 4	85 0	80 4	80 5	85 4	87 0	85 3
Total	**498 8**	**456 2**	**418 6**	**397 8**	**387 3**	**397 1**	**389 7**
Power stations							
Consumption	58 4	53 9	44 7	40 0	31 2	41 2	29 5
Change in stocks	1 7	− 0 4	0 6	− 1 4	− 2 7	− 0 1	0 3
2 Natural gas (Mtoe)							
Primary production	136 8	129 4	125 5	116 1	119 9	120 4	122 5
Imports [2]	37 4	43 5	46 2	45 8	50 1	57 9	60 7
Apparent consumption	172 8	169 0	164 9	158 5	165 1	175 4	182 3
of which							
in power stations	24 4	20 3	16 9	16 6	18 8	20 6	21 1

[1] Crude oil and Petroleum products
[2] Imports from third party countries
[3] Forecast

Table 4 — Solid fuels. Supply and Disposal in the European Community

	1979	1980	1981	1982	1983	1984	1985[1]	1986[1]
1 Hard coal (Mt)								
Primary production	245 1	253 6	252 2	248 4	235 2	162 2	206 2	231 9
Change in stocks								
Collieries	- 5 6	10 7	8 9	4 2	0 5	- 8 3	- 12 4	11 0
Power plants	- 2 3	6 7	6 2	7 9	2 5	- 13 7	13 2	7 4
Net imports	58 4	74 2	66 5	70 0	57 0	78 9	71 0	62 2
Apparent consumption	311 4	310 3	303 6	306 2	289 2	263 1	276 4	275 6
Deliveries to								
Power plants	166 4	179 2	176 5	184 0	175 8	131 9	165 6	160 3
Coking plants	87 6	88 4	85 2	80 1	69 7	69 7	74 0	71 0
All industries	22 4	22 7	24 0	24 5	25 4	24 8	27 4	28 5
Households	19 9	18 0	16 0	16 5	15 9	13 1	15 3	16 5
Total	296 3	308 4	301 7	305 2	286 8	239 6	282 4	276 2
2 Hard coke (Mt)								
Coking plants								
Production	67 6	66 3	64 2	60 2	53 5	52 8	54 8	53 8
Change in stocks	- 8 9	0 8	- 0 1	3 8	1 4	- 5 3	- 2 6	1 3
Deliveries to the iron and steel industry	58 4	54 3	52 6	46 3	41 8	48 5	48 7	48 4
3 Lignite								
Production (Mt)	158 2	157 0	162 4	159 3	158 7	162 0	163 3	168 7
Consumption in power stations (Mtoe)	25 9	26 2	27 6	26 6	27 3	27 0	28 5	29 0

[1] Forecast

Table 5 — Electricity Supply, disposal and generating structure in the European Community

	1979	1980	1981	1982	1983	1984	1985[2]	1986[2]
Electrical power (TWh)								
Total generation	1 267 5	1 277 6	1 274 6	1 271 4	1 299 8	1 360 5	1 417 6	1 452 3
Total net production	1 198 8	1 208 7	1 206 1	1 202 9	1 229 1	1 286 6	1 340 2	1 371 8
of which								
Hydroelectrical	143 9	146 1	149 1	146 1	144 8	141 5	146 2	148 8
Nuclear	127 6	149 4	201 7	226 9	275 0	352 8	426 5	497 3
Conventional thermal	927 3	913 1	855 2	830 0	809 3	792 3	767 6	725 7
Gross inland consumption	1 283 9	1 291 7	1 296 8	1 290 8	1 321 6	1 375 1	1 436 0	1 472 3
Available for internal market	1 206 5	1 213 9	1 217 4	1 212 0	1 237 9	1 287 3	1 346 5	1 380 8
Input to thermal power stations [1] (Mtoe)								
Hard coal	88 1	92 9	91 9	94 7	96 1	80 8	84 5	88 4
Lignite	25 9	26 2	27 6	26 6	27 3	27 0	28 5	29 0
Petroleum products	57 9	53 4	44 3	39 6	30 9	40 9	29 2	14 6
Natural gas	24 4	20 3	16 9	16 6	18 8	20 6	21 1	23 2
Derived gas	1 7	1 7	1 8	1 5	1 3	1 5	1 5	1 5
Total	197 4	193 7	182 2	178 2	174 0	171 7	165 8	157 0
Net Nuclear capacity (GW)	22 8	26 7	34 4	40 2	43 8	50 6	62 8	75 6

[1] Conventional thermal plants in the public supply system
[2] Forecast

Community news

Energy policy: the roles of the Community institutions

How are energy matters handled in the European Communities and which institutions are involved? What are their specific responsibilities? What are the links between them? And how do their roles differ from those of the International Energy Agency in Paris? This short guide to the Community institutions explains [1]

The four main institutions

The achievement of the aims of the European Communities is the responsibility of four main institutions — the European Commission, the Council of Ministers, the European Parliament and the Court of Justice Alongside these four institutions there is also a Court of Auditors, which audits the accounts of the Community bodies and checks on financial management, and two committees, representing the various sectors of the economy (the Economic and Social Committee and the Consultative Committee of the European Coal and Steel Community), established to assist and advise the Commission in the formulation of its proposals

The European Commission

The European Commission consists of 14 Members (former senior politicians or civil servants) who are nationals of the Member States of the Community yet independent of them The Commission is the source of proposals for Community action and only in rare cases can decisions be made in the Community without a proposal from the Commission The Commission therefore has a permanent duty to **initiate action.** It is also the executive arm of the Community, with extensive **rule-making powers** vested in it by the three Treaties governing the Community (the Coal and Steel Community Treaty — ECSC, the Euratom Treaty and the EEC Treaty) It is responsible for ensuring that the **rules of the Treaties are respected.** More generally, it is the exponent of the **Community as against national interest.**

The Commission acts as a collegiate body but its members have specific portfolios Nic Mosar, the Commissioner from Luxembourg, is responsible for the energy portfolio He is assisted by a small personal and political staff (Cabinet) and by some 370 civil servants (fonctionnaires) of the Directorate-General for Energy (DG XVII) of the

The Berlaymont building in Brussels — headquarters of the European Commission

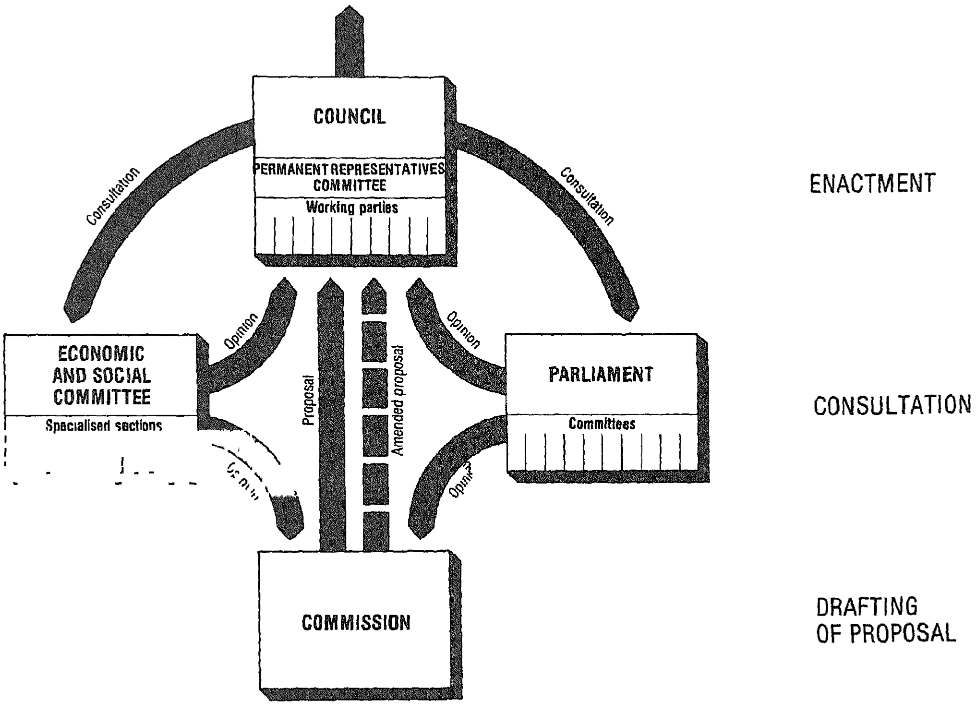
Commission, based in Brussels and Luxembourg At their head is the Director-General for Energy Christopher Audland

The Council of Ministers

The Council, by contrast, is made up of the representa tives of the governments of the 10, soon to be 12, Mem ber States of the Community Its membership varies wit the subject under discussion On energy matters th Council is normally composed of Ministers for Energ from each Member State The Commission takes part i all Council meetings The chairmanship, or Presidenc of the Council rotates between Member States on a si monthly basis From 1 July to 31 December 1985 L xembourg is in the chair The Council is supported by secretariat of permanent official based in Brussels Mini terial meetings are prepared by specialized groups of of cials from Member States (the so-called Energy Grou and High Level Energy Group) and by a Comittee of t Ambassadors (Permanent Representatives) of Memb States to the Community These meetings too have rot ing chairmanship and Commission representation at st level.

[1] A fuller description of the Community institutions is to be found in 'Working together' 'the institutions of the European Communities — 1985 edition' by Emile Noel, in the series European Documentation, available from the Office for Official Publications of the European Communities

THE COMMUNITY'S DECISION-MAKING PROCESS



n simple terms, except when legal powers have already ɔeen gıven to the Commıssıon ın the Treatıes, the Comnıssıon proposes and the Councıl dısposes The Councıl annot ıtself amend Commıssıon proposals except by ınanımıty It can, however, take decısıons ın lıne wıth ɔommıssıon proposals ın many cases on majorıty vote ɔnly — ın theory at least In practıce, however, the maorıty vote has been used less frequently than envısaged ınd decısıon-makıng ıs more often the result of a lengthy dıalogue' between the Commıssıon and the Councıl beore a consensus ıs reached on the way ahead

The European Parliament

The Treatıes make the Commıssıon answerable to the uropean Parlıament alone The Parlıament, whose 434 ıembers are now dırectly elected by unıversal suffrage, as to be consulted on the Commıssıon's more ımportant roposals under the three Treatıes **before** the Councıl akes a decısıon If Parlıament censures the Commıssıon, the latter's members must resıgn as a body Parlıament also has a crucıal role ın determınıng the Communıty's annual budget, ıncludıng the bulk of expendıture on energy

Much of the work of the Parlıament ıs handled ın specıalıst commıttees The Energy, Technology and Research Commıttee covers energy matters Its current chaırman ıs Mıchel Ponıatowskı (F-Lıb). The actıvıtıes of the Parlıament wıll be reported regularly ın *Energy ın Europe.*

The Court of Justice

The Court consısts of 11 judges appoınted for sıx years by agreement among the governments Its responsıbılıty ıs to rule on whether there have been breaches of the Treatıes or subsequent Communıty legıslatıon and on the ınterpretatıon and applıcabılıty of Communıty law ın natıonal cırcumstances Cases can be brought by eıther the Commıssıon ıtself (exercısıng ıts role as guardıan of the Treatıes), Member States, ındıvıduals or enterprıses

Energy policy in practice

Many of the basic Community aims in the fields of coal and nuclear energies were defined by the ECSC and Euratom Treaties themselves

The **ECSC Treaty** provided, inter alia, for the abolition of duties and quantitative restrictions on trade in coal (and steel) between Member States, the removal of discrimination in prices, the outlawing of restrictive practices tending towards collusive sharing or exploitation of markets

The **Euratom Treaty**, for its part, gave the Community the task of creating the conditions necessary for the speedy establishment and growth of nuclear industries in Europe, and it made specific provisions for a Community responsibility in a wide range of areas, including notably

(i) the promotion of research and development,

(ii) health protection,

(iii) the supply of nuclear materials,

(iv) the establishment of a system of safeguards to ensure that nuclear materials are not diverted from their intended use,

(v) the development of relations with third countries

The **Treaty** establishing the European Economic Community was much less specific in the energy field But it has provided a legislative, political and financial framework for the development of a wide range of actions at Community level.

As far as legislation is concerned, two important Community agreements should be cited ever since 1968 there has been Community legislation on the holding of minimum oil stocks by Member States, and since 1975 Community legislation has limited the use of oil and natural gas in power stations

Key political agreements have been the establishment of long-term Community energy objectives, common energy pricing principles, and guidelines for action in the field of energy savings

Expenditure on energy financed from the Community's general budget and the special budget applying to the Coal and Steel Community is also far from insignificant In 1983, for example, some 340 million ECU were spent by the Commission, on behalf of the Community, to finance research and development in the energy field, and a further 100 million ECU in support of new technological projects reaching the stage of commercialisation The breakdown of Community expenditure in the energy field was analysed in more detail in No 1 of *Energy in Europe* Future issues will bring news of progress on some of the specific projects receiving financial support from the Community

Links with the International Energy Agency (IEA)

The Community's role and responsibilities in the energy field differ from those of the IEA in Paris, but there are close links between the organizations What are the essential differences?

(i) **membership** The IEA — founded in 1974 as an autonomous agency of the OECD — has 21 members compared with the 10 (soon to be 12) members of the Community But France is not a member The IEA provides a framework for dialogue and cooperation on energy within the industrialized world and notably between the three main groups of industrialized countries — Western Europe, North America and Japan

(ii) **responsibilities** The IEA was a response initially to the first oil crisis of 1973-74 and it has a particular responsibility in consequence for oil-sharing arrangements among its Member States in a crisis In view of this there is extensive involvement of the oil industry itself in the Agency's activities, through a series of advisory boards The IEA has, however, widened its responsabilities over time with the development of a programme of long-term energy cooperation among its Member States, based on a series of agreed common principles of action The Community's responsibilities are more specific than those of the IEA in some sectors (natably coal and nuclear), they are also set in the context of wider Community aims (notably, the development of the European common market and strategies for European industry and technology)

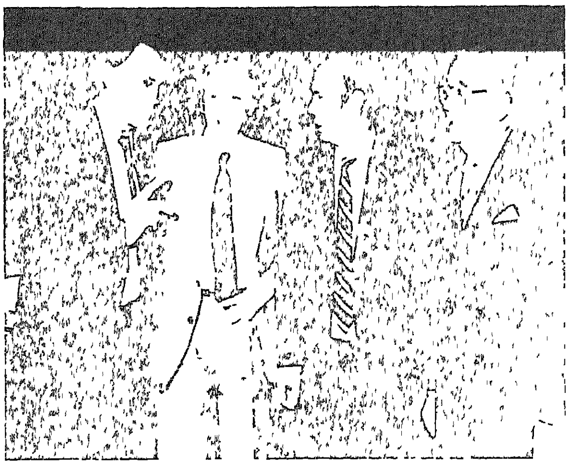
(iii) **rule making** The IEA takes decisions and makes recommendations to its member countries its Governing Board — composed of Energy Ministers, or, more frequently, senior energy officials from the participating countries These are political decisions often imposing important obligations on Member States without the force of legal sanctions Many decisions in the Community are based similarly on political

rather than legislative agreements, but there are also extensive rule-making and policing powers vested in the Community institutions by virtue of the Treaties

) **finance** The IEA provides an umbrella for collaborative technological ventures between its member countries But it does not itself give financial support Its budget is restricted essentially to staff and associated administrative costs As indicated earlier, the Community, on the other hand, is financing energy research, development and demonstration on a sizeable scale, as well as technical assistance to energy management and planing in developing countries

The activities of the two organizations are complementary and there are close working relationships between the IEA Secreatariat and the staff of the European Commission The Commission also participates in meetings of the Governing Board of the IEA and its associated standing committees The results of the latest meeting of the IEA Governing Board are summarized in a separate article below

Energy Council, 20 June 1985



From left to right, Luxembourg's Energy Minister Mr Schlechter, Italy's Permanent Representative to the EC, His Excellency P. Calamia, the President of the Energy Council, Italy's Energy Minister Mr Altissimo, and EC Energy Commissioner Nic Mosar during the last Energy Council in Luxembourg

The Council was held in Luxembourg under the chairmanship of the Italian Energy Minister, Signor Renato Altissimo, with Energy Commissioner Nicolas Mosar representing the Commission

In contrast to the protracted negotiations that have taken place in the past, the Energy Council on 20 June reached a quick consensus on the important political points that needed to be resolved to allow the Community's demonstration hydrocarbon technology programmes to continue beyond the end of this year The Council decided that both schemes should be extended by four years, with 90 million ECU per year allocated to demonstration projects (which embraces projects in the fields of energy conservation, renewables and solid fuels) and 35 million ECU a year for hydrocarbon technology projects The details of the necessary regulations remain to be worked out but the Council's political orientations have been taken

The Council devoted considerable attention to the follow-up which the Commission had undertaken since the March Energy Council on the question of increased oil product exports from the Middle East The Commission's discussions with producing countries and with Japan and the US had confirmed its view that world markets should be able to cope with these additional supplies provided there was equitable access to all main markets

Restriction of access to the Japanese market was a cause of concern At the Council, Energy Ministers reaffirmed the coordinated EC approach which has been put forward during the preparations for the IEA Ministerial meeting on 9 July The essence of the Community's approach is that industrialized countries should agree to maintain or create the necessary market conditions to allow oil products to circulate freely This position was subsequently adopted by IEA Ministers on 9 July — see relevant article on IEA Ministerial meeting

One area though where the Council failed to make headway was on energy pricing In September 1984 the Commission had produced a report on the application in Member States of the previously agreed energy pricing principles This report has been under examination at working level, the aim being to try to reach a political agreement on pricing practices in gas and electricity sectors Since negotiations at working level had been unsuccessful, a final attempt was made at the Council to achieve a solution Regrettably, the political difficulties were not overcome Commissioner Mosar affirmed however that in the absence of a political solution, the Commission would continue its efforts to improve pricing policies and transparency in the gas and electricity sectors through the powers in the Treaty of Rome and the pricing principles previously approved by the Council

There was also a new Commission Communication (COM(85) 245 final) before the Council suggesting new energy objectives for the Community This important document proposes horizontal and sectoral energy objectives for 1995 The broad lines of the Commission's initiative were welcomed by Ministers The Commission proposals will now be examined in detail by the Energy Working Group, and will be considered again by Ministers at their next meeting

The next Energy Council, which will be held under the Luxembourg Presidency, will probably take place in November

IEA Ministerial meeting

This article highlights some of the points discussed at th International Energy Agency meeting in Paris on 9 Jul which were of particular interest to the Community

The theme of the IEA Ministerial meeting was 'Lessons (the past and tasks for the future' It was the first meetir

Ministerial level since 1983 and coincided with the :A's 10th anniversary The meeting therefore provided ı opportunity to reflect on the changes that have taken lace in the energy situation since 1973 and on the mea- ıres needed to ensure that renewed energy difficulties re not encountered in the 1990s

he issues discussed at the IEA Ministerial meeting cor- esponded in many ways with the work on future policies vhich has been going on in the Community during the ›ast 18 months Following its major review of Member ›tates' energy policies in early 1984, the Commission has since published its Energy 2000 study and has now pro- posed new energy objectives for 1995 The present re- spite in energy markets has in fact allowed all concerned to look in some depth at longer term policy issues

A common theme expressed by many Ministers at the IEA, including Energy Commissioner Mosar, was the need to maintain strong energy policies and not be misled by short-term market signals There was a remarkable degree of consensus on the main issues that needed to be faced, which were set out in a communiqué and conclu- sions adopted by the Ministers

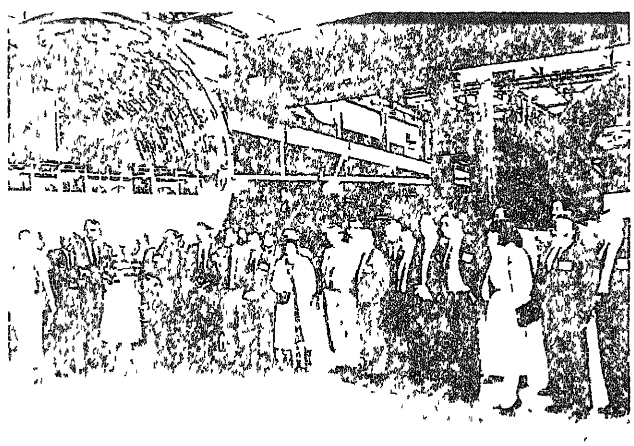
Of particular interest to the Community were the discus- sions on the build-up of refined oil product exports from the Middle East and North Africa The Commission's suggested approach had been agreed at the Energy Coun- cil on 20 June (see separate article) and had been submit- ted to the IEA Ministerial meeting, as a possible means of coping with the problem The basic point at issue was the risk that restrictions on oil product imports into Japan could oblige other countries or regions to take additional amounts of these products Considerable discussion took place at the Ministerial meeting on the way in which the issue should be dealt with Having a common position enbled the Commission, with support from Member Stat- es, to influence strongly the course of discussion The ag- reements reached by IEA Ministers meets a key require- ment of the Community, ie, that no country should be able to shift its burden of adjustment to others The com- mon approach will be to allow these refined products to flow according to normal world market patterns This outcome is important for the Community, not only in that it conforms to the approach put forward by the Commission and EC Member States at the Ministerial meeting, but as an effective response to calls for protec- tionist measures The EC will be cooperating with the IEA in monitoring of the implementation of this agreement

The need for energy policy to take account of changing concerns is reflected in the detailed conclusions adopted by the IEA Ministers on energy and the environment For the first time at such a forum Energy Ministers have ag- reed that an integrated approach should be followed to ensure a satisfactory balance between energy and envi- ronmental objectives

European Parliament – Committee on Energy, Research and Technology (CERT)

Two important dossiers which have been in front of the committee have been the Commission's proposals on hy- drocarbon technology projects and on energy demonstra- tion projects As far as the first is concerned, the report by Madron Seligman (ED, United Kingdom), which basi- cally approved the proposal, was adopted by the European Parliament on 14 June

The proposals on demonstration projects relating to al- ternative energy sources, energy saving, hydrocarbons substitution and liquefaction and gasification of solid fuels were the subject of a report by Giovanni Starita (PPE, Italy), which was adopted by the committee at its meeting on 15 and 16 July, with a view to being debated in the September plenary session (9 to 13 September)



Members of the European Parliament's Committee on Energy, Research and Technology

The report is very positive towards the demonstration programme On the contents of the programme the re- port welcomes the Commission's proposals, encourages a

better dissemination of results and urges that, if the reimbursement clause is abolished, the Commission should only support those projects which really need financial support

* * *

Parliament finally adopted the 1985 Budget at its June session. The Committee was reasonably satisfied with the outcome as regards Chapter 70 (Energy), except for the fate of its amendments to increase funding for Article 706 (Energy programming) and Article 709 (Studies in the energy sector), which were ultimately unsuccessful The Committee's draftsman of opinion for the 1985 Budget was Gordon Adam (S, United Kingdom) Work has already started on the preparation of the 1986 Budget, for which the draftsman is Jacques Mallet (PPE, France)

* * *

Nuclear matters are occupying considerable attention, with three reports in this area currently, before the Committee a report by Undine Bloch von Blottnitz (Arc, Germany) on advanced reactor systems, a report by Paul Staes (ARC, Belgium) on discontinuing the nuclear powered production of electricity and a report by Llewellyn Smith (S, United Kingdom) on a motion for a resolution tabled by Carole Tongue (S, United Kingdom) on an alleged contravention by the United Kingdom Government of the Euratom Treaty The Bloch von Blottnitz and Smith reports have already been the subject of preliminary discussion in the committee

* * *

European Community policy on coal has been a constant preoccupation in recent months The Committee has been awaiting with great interest the Commission's final proposals on solid fuels policy and on a regime of national subsidies, which expires in 1985 The Committee's rapporteur is Lambert Croux (PPE, Belgium) The Commissioner, Mr Mosar, addressed the committee on this subject on 14 May

* * *

Looking ahead, one of the most important items in the Committee's future work will be the report on the new Community energy objectives for 1995 The rapporteur is Mr Adam The committee will be attaching great importance to a thorough examination of this matter.

Economic and Social Committee

At its plenary session at the end of May, in the presence of Mr Mosar, the Economic and Social Committee adopted its opinion (Rapporteur Mr Querleux, France, Employers' Group) on the third illustrative nuclear programme (PINC) submitted by the Commission

The PINC report is concerned in particular with nuclea energy production targets and all types of investment re quired for their attainment

The Committee considers that the line of approach to th development of nuclear energy proposed in the PINC i logical and approves the PINC's message that the Com munity has a basic interest in reducing its dependence o imports of uranium by pursuing a supply strategy based among other things, on continued prospecting and a poli cy for the reprocessing and temporary storage of use fuels

The Committee also agrees that preparations should b made for the achievement of economic competitivene by the next generation of fast breeder reactors in acco dance with the programme set out in the PINC, by check ing at each stage the technical and economic reliability o the reactors

The Committee considers that the PINC does not lay su ficient emphasis on the problems that still arise (wit wide variations from one country to another) in conne tion with the acceptance of nuclear energy by public opi ion The Committee therefore recommends that all dat concerning nuclear energy should be presented to th public in a campaign dealing clearly and frankly wi questions with which the public is unsufficiently famili

More generally, the Committee suggests that the PIN should specify more clearly the action to be embark upon by the end of the century in the crucial areas of th reprocessing and interim storage of irradiated fuel el ments and the management of radioactive waste, with th aid of an initial set of indicative deadlines to be update by means of 'rolling plans'

Lastly, the Committee asks the Commission to pla greater emphasis on the major importance of great Community political will in the implementation of inve ment programmes concerning the various aspects of nu lear energy

* *

ıe Committee's Energy Section adopted a report in July '85 on **Energy options** (full title. Environmental con- aints and their implications for Community energy)licy) — Rapporteur. Prof von der Decken, Germany, arious Interest Group The report demonstrates clearly)w important it is to understand the interaction between ı) the problems of energy production and utilisation and) environmental problems, and to take them into ac- ount in a joint energy/environment policy

'he report starts out by asserting that global energy re- ources are so great that even a world population which is ıll much on the increase, can be supplied for a long time yet We are not facing an energy supply problem so much as a problem of organizing ourselves — and paying for — environmentally clean energy

The section pays tribute to all the measures so far taken to reduce atmospheric pollution, pollution of sea water etc However, the risk of ever-increasing pollution as the use of fossile fuels builds up, is becoming so great that the Community can no longer afford to have energy and environmental policies dealt with separately This is an ıstitutional as much as a technical matter

Whilst acknowledging that a variety of technical, legal as well as political measures can be used, the section's report proposed that we target our energy strategy on 'zero-emission' This calls for something of a revolution in energy production Instead, for instance, of the vertically-integrated energy systems we are familiar with, we should go for horizontally-integrated energy production systems

The report concludes with the hypothesis that towards 2030 liquid fuels (methanol) synthesized from solid fuels, will themselves be as important a source of energy for us as oil is today

The Committee, in its meeting of 3 July 1985, adopted a report given by Mr Paul Flum (Federal Republic), rapporteur of the Section for Energy and Nuclear Questions, on the new demonstration regulations The report points out the positive effects of the programme in terms of improving the energy situation in the Community, job creation, conservation of the environment and on export opportunities It states that the demonstration project scheme should be adopted

(i) with no cuts in the planned expenditure,

(ii) with no reduction in the planned duration of five years,

(iii) and with provisions for an extension at the appropriate time

ECSC Consultative Committee: Main activities in the energy field

At its 249th session on 29 March 1985, the Committee debated a draft document, prepared by the Commission's services, on the solid fuel market in the Community in 1984 and the outlook for 1985 This document, which was subsequently revised to take account of the Committee's comments, has now been published (Official Journal C 177) Such consultation is carried out each year in accordance with the procedure laid down in Articles 19 and 46 of the ECSC Treaty On this occasion, the debate covered not only the document itself but manifold aspects of coal policy, and the Committee took the opportunity of passing a resolution expressing its concern that a healthy level of domestic Community coal production should be maintained

At the same session, the Committee approved the Commission's proposals for the 1985 ECSC coal research programme, based on Article 55 (2)(c) of the ECSC Treaty and involving 72 projects concerned with coal production and use Proposed expenditure amounted to 23 1 million ECU, 19 million ECU being earmarked from the ECSC levy for first priority projects, while the financing of the remaining projects was left open

Its 250th session, on 28 June 1985, saw the Committee debate the Commission documents 'Energy 2000'[1] and 'New Community energy objectives'[2] (to 1995) The Committee passed a resolution referring to these documents and calling on the Commission, among other things, to give a more prominent position in Community energy strategy to coal and other secure energy sources, and to take all appropriate steps to foster both the consumption of coal and its production within the Community

Note: Since the last issue, the appointments have been made of Mr A Scargill and Mr P Heathfield as representatives of the coalworkers to the ECSC Consultative Committee

[1] SEC(58) 324
[2] COM(85) 245 final

ETUC – European Trade Union Confederation

Energy work programme as adopted by the Executive Committee meeting 18 and 19 April, 1985

The ETUC is an organization which comprises 35 national confederations of trade unions in 18 countries The member organizations have altogether more than 40 million individual members It is the only European organization of national trade union centres and more than 80% of the trade unionists in Western Europe are organized in ETUC affiliations The ETUC is recognized by the European Community as the sole representative of trade unions at the European level

As far as the energy sector is concerned, no special industry committee exists The Executive Committee of the ETUC decided in 1978 that energy matters should be dealt with by the ETUC Coordinating Committee on energy and later attempts to establish an industry committee within the energy sector was stopped by some of the larger trade union confederations within the Community ETUC has therefore been given the mandate to represent the trade unions in Western Europe, both to safeguard sectoral interests of trade unions within energy production plans and the respective energy policies of the trade unions in general ETUC thus claims to represent trade unions both as producers and consumers of energy

Over recent years, the Committee has increasingly focussed its work on issues of practical importance to unions in the energy industries It has also attempted to coordinate its work within the framework of general ETUC economic and employment policy In particular, ETUC's work on energy questions has to be part of the campaign to restore full employment and to improve the quality of life throughout Europe

The ETUC's general principles of energy policy are set out in the ETUC energy programme, adopted by the Executive Committee in December 1980 That energy programme provides the basis for the Coordinating Committee's work

The issues set out in this work programme form the Committee's priorities for the coming year

The main areas covered by the work programme are the following

(i) energy policy and employment,

(ii) energy research and development,

(iii) acid rain,

(iv) energy efficiency,

(v) the oil refining industry

ETUC's opinion is that trade unions should play an important part in planning, decision-making and development of energy policies at all levels and ETUC is therefore willing to contribute in this way whenever possible

At the last ETUC Energy Coordinating Committee meeting in Brussels on February 26 and 27, 1985, a decisio[n] was made to start work on an ETUC position and polic[y] for immediate action in the coal, nuclear power and ga[s] industries The Committee will do so in close cooperation with its affiliated national organisations and the industry committees

Commissioner Mosar in Oslo

As a major and secure supplier of oil and gas to the European Community Norway has long received priority i[n] the EC's international energy relations Regular contac[ts] have been maintained with Norway in this field over th[e] past few years Mr Nic Mosar's first official visit to a capital of a country outside the EC — since he took office i[n] January last — therefore brought him to Oslo Mr Mosar, accompanied by the Director-General for Energ[y] Mr Christopher Audland, met Mr Kåre Kristiansen, th[e] Norwegian Minister for Energy and Mr Torbjø[rn] Frøysnes, State Secretary for Foreign Affairs on 26 Apr[il]

Mr Kristiansen informed Mr Mosar about Norwegi[an] production developments regarding gas and oil Mr Kri[s]tiansen appeared optimistic about the prospects of a de[al] with Community gas companies on Troll He recognis[ed] that the gas would have to be sold under competiti[ve] conditions if it was going to be contracted

Regarding natural gas, Mr Mosar confirmed that th[e] Community would need additional imports in the mi[d] 1990s and expressed the hope that substantial quantiti[es] would come from Norway He agreed on the importan[ce] of competitive conditions Mr Mosar also informed t[he] Norwegian Minister about the concern of some Community firms about the extent to which the market f[or] offshore goods and services would be open to Commu[n]ity bidders

r Frøysnes underlined the usefulness of the bilateral exange of views on energy matters which was initiated by r Davignon, the former Energy Commissioner It was orway's intention, as far as was economically possible, increase their contribution to the Community's supply oil and gas, in line with the IEA policy guidelines of ay 1983 Although Norway regretted that no deal had en possible with the UK on the sale of Sleipner gas, orway would now concentrate on the sale of Troll gas the European Continent

elations with South-East Asia

uth-East Asia is assuming growing importance in the orld energy picture Energy demand in the region is ineasing rapidly with successful industrialization, and idonesia, Brunei and Malaysia are now important oil oducing and exporting countries There are also major atural gas reserves in the region and considerable hydrower potential Singapore is one of the world's major oil fining centres For both energy and foreign policy reans the Commission favours strong relations with this ea

fficials from the European Commission's Directorateeneral for Energy (DG XVII) visited South-East Asia in larch/April this year Clive Jones, Director for Energy olicy, and Hans-Eike von Scholz, who is in charge of G XVII's energy cooperation programme, attended an ternational energy seminar in Thailand which was onsored by the Commission under the DG XVII progimme and organized by the Asian Institute of Technogy (AIT) This occasion brought together the leading fiires from an international network of 11 energy institites which has been carrying out work for the Commison on planning methods suitable for Third World engy situations The 11 institutes are located in Latin merica, India, the Middle East, China, West Africa, urope and Thailand itself (AIT)

s well as presenting the Commission's programme and ie network's activities to an invited audience from Thaind and elsewhere, the seminar enabled the members of ie network to discuss and reach agreement on their ork programme for the next three years The next iase of the work will concentrate largely on using the anning methods which have been developed to carry it planning studies in selected developing countries As irt of its own contribution to the network's activities, AIT has already drawn up energy balances for Indonesia, Malaysia, Thailand and the Philippines, as well as carrying out four studies of rural energy problems in the region

The DG XVII representatives also held discussions during their visit with the **Thailand National Energy Administration** and reached agreement in principle on a two-year energy planning cooperation project This joint project will concentrate on setting up a national energy data system in Thailand and on methods of forecasting energy demand It will also include a training programme for national officials with a view to establishing an energy planning unit in NEA

The Commission therefore intends to expand its energy relations with South-East Asia, both bilaterally and through its relations with Asean Support has already been provided for the region in the form of scholarships for energy planning studies at AIT and reinforcement of AIT's faculty with EC-financed lecturers The Commission has also agreed to cooperate with Escap, the UN organization for South Asia, in holding a series of energy planning seminars in the region of 1985/86 On the return journey from Thailand, Mr Jones visited both Malaysia and Singapore and held discussions with the main government agencies and energy industries in those countries

The third Arab Energy Conference held in Algiers from 4 to 9 May

A Commission delegation headed by Commissioner Mosar attended the third Arab Energy Conference held in Algiers from 4 to 9 May Mr Mosar gave a statement about the Community's experience with regard to energy cooperation with the developing countries

The Commission was the only non-Arab political organization to be invited It was also the first time that a Member of the Commission was directly involved (at the invitation of the Organization of Arab Petroleum Exporting Countries — Oapec) in this Conference which has met every three years since 1979 The fourth Conference is scheduled to be held in Baghdad in March 1988.

Mr Mosar took this opportunity of meeting several Arab Energy Ministers and the Algerian authorities

The contacts made confirmed the Arab World's interest in international energy cooperation, in particular with the Community It emerged from discussions with members of the Gulf Cooperation Council and Algeria that these countries are interested in a rapprochement with the Community and wish to reactivate the cooperation agreement concluded with the Community in 1976, where some of them are concerned, and to lay the foundations for more formal relations with the EEC, where others are concerned

Eurostock

The 1985 trial phase of the European Community financed European rapid oil stock reporting system is in full swing Currently over 80 oil companies covering over 80% of the Community's primary oil stocks are participating in the scheme Participating companies send their end-month stock figures shortly after the end of the month to the international firm of accountants Klynveld Kraayenhof & Co (KKC) in the Netherlands who guarantee the confidentiality of the data Thereupon the participating company data is added up and scale-up formulae applied (developed by the consultants Joe Roeber Associates) to estimate the total stock level for each Community country for four stock categories (crude, mogas, middle distillates and residual fuel oil) Shortly after, telexes are dispatched to the participating companies and Member State governments with the estimated data Stock data is therefore available two months before national statistics or those of the International Energy Agency (IEA) are published

Although the system has only been running since January 1985, there has been a detectable increase in overall accuracy of the estimates with a significant portion of the estimates falling within a 0-4% error tolerance range Substantial efforts have been undertaken to clear up definitional problems in some countries and renewed attempts have been made to encourage more companies to participate

At the end of September, a meeting will be held in Brussels to which participating companies will be invited to discuss the future of the Eurostock system from 1986 onwards

Mr Georges Brondel retires

Mr Georges Brondel, Director for Oil and Natural Gas in the Directorate-General for Energy for the past 15 years, retired at the end of May

His name is closely associated with all the Commission's major activities concerning petroleum, gas and energy in general over the last 25 years

In recognition of his services, the Commission has appointed him Honorary Director-General

With a background in engineering, law and economics, Mr Brondel was Head of the Energy Economics Division in the old EEC Commission, then Adviser in the Directorate-General for Energy and finally Director for Oil and Natural Gas, his competence was recognized well beyond the frontiers of the Community

Mr Robert De Bauw, Head of Division in the same Directorate, has been appointed Acting Director for Oil and Natural Gas from June 1985

Demonstration programme

Evaluation of programme

Some time ago the Commission invited a group of four independent experts[1] to evaluate the Community Energy Demonstration Programme Their report was published by the Commission in February 1985 (COM(85) 29/2) Its generally favourable overall conclusions were presented in the last number of *Energy in Europe*

[1] Henri Durand (Chairman), University of Paris,
Angelo Airaghi, Finmeccanica, Rome,
Hans Hertlein, DFVLR, Koln-Porz,
Morton Lange, Copenhagen, University

This article gives a brief summary of the experts' conclusions on the particular sectors within the programme

Energy saving in buildings
The experts recommend continuation of this programme, keeping the present severe selection criteria which avoid unnecessary duplication with national programmes

They felt that the priorities should be

(i) **retrofitting techniques**, to expand the trend which exists already for new buildings, thanks to improved standards,

(ii) **the non-residential sector**, which allows for more advanced technologies and can be particularly useful in training architects and engineers in modern techniques

Energy saving in indusry
This sectoral programme is considered very successful It needs, however, to be followed up by replication and multiplication With that remark in mind, the programme should otherwise be vigorously pursued

Energy saving in transport
Given that in the past only a limited number of good applications have been received in its sector, and the special features of the transport market, the experts recommended that invitations to tender should be better defined by giving more detailed information about objectives, technical priorities, etc Since this sector is very important for overall energy consumption, efforts to make this programme more effective are fully justified

Energy saving in energy industries
This programme is both promising (by virtue of its major potential) and disappointing (because of the difficulties attached to bringing contractors together to set up large projects) Proposals should therefore be discussed and selected on a case by case basis with greater attention to truly innovative technologies (e g large heat pumps, use of waste and solid fuels)

Energy saving in agriculture
The experts suggested that this rather small programme should be discontinued as such, while continuing to make agricultural projects eligible for other sectors like biomass and waste, buildings, or use of heat

Solar energy
A limited demonstration programme should be pursued under the following conditions

(i) sub-sectors such as passive solar and medium temperature applications should be given priority,

(ii) photovoltaic applications need more demonstrations, in Europe and in developing countries, in order to popularize their specific interest, increase industrial production and hence reduce costs,

(iii) selected active thermal applications, and their related storage should be funded under a long-term approach

This type of continuity in the demonstration programme was felt to be necessary, supported by an active R&D programme, to create the conditions for a gradual but constant development of solar energy in Europe

Biomass and energy from waste
Despite the limited result so far achieved and the great diversity of projects, the experts provisionally indicated the following technical priorities for the future

(i) end-use of agricultural by-products,

(ii) advanced combustion and gasification processes,

(iii) urban and industrial treatment,

(iv) harvesting poorly exploited forests (coppices) for both energy and paper-pulp sectors

With these technical priorities, the biomass/waste demonstration programme should be continued In spite of the present competition with relatively cheap fossil fuel, its short-term potential in Europe is significant, its consequences for the environment are excellent and the long-term perspectives are even more promising

Geothermal energy
The experts conclude that such a programme should undoubtedly be continued, with the following priorities

(i) first, experimental drillings in little-known areas ('mining-risk'),

(ii) second, pursuing technological innovation tests on new drilling methods and on specific hardware,

(iii) third, financing selected 'classical' operations in those countries lacking sufficient experience but offering interesting potential

Small hydro-electric power generation
As a preliminary conclusion, the experts state that if a new call for tenders is to be launched in the next one or two years, it might be advisable to include applications such as the direct use of electrical power by industries, or the combination of optimal self-production with grid-power, rather than straightforward general purpose electricity generation.

Wind energy

This programme should be pursued, but, in the light of the experience gained through the first call for tenders, with a greater emphasis on more limited specifications — and/or applications — making use of national expertise and improved evaluation of wind energy potential in various climatic and economic conditions

Use of solid fuels

This programme stems directly from one of the priorities in Community policy Experience gained since 1983 should help to provide a better identification of this area In spite of its inconveniences, coal still offers good prospects for Europe Efforts should therefore continue to promote the use of solid fuels Environmental concerns should also be central to this programme

Use of heat

In the future, more attention should be paid to industrial projects (especially in the storage area), and also to management and monitoring of large heat networks

The evaluation report is available in all Community languages (reference COM(85) 29/2) from DG XVII or the Community's press and information offices

Council Decision on demonstration programme

At its meeting of 20 June 1985, the Energy Council agreed in principle on the continuation of the demonstration programme for another four years (1986-90), and indicated an 'amount considered necessary' of 360 million ECU for the total period. This orientation by the Council also includes the proposed adoption of a single regulation for the whole programme (ie including liquefaction/gasification of solid fuels) The Commission will be invited to prepare, one year before the end of the programme, a report on the necessity of its continuation or the introduction of other measures. On that basis, the Commission intends to publish a new call for tenders by the end of 1985

Energy demonstration projects workshops

Programme

As one way of encouraging the replication of successful projects carried out with aid from its energy demonstration programme, the Commission (Directorate-General for Energy) arranges, in collaboration with project participants, a series of workshops to further publicize the technology of these projects Three of the most recent are described below In addition, a workshop was held in June at Elf-Aquitaine's Grandpuits refinery outside Paris (Project EE/125/80/F) and centred on the various applications of the very successful oil separation system for water-oil emulsions A further series of workshops is planned for the latter part of 1985

Workshop on solar energy and building design (Birmingham, UK, — 11/12 April 1985)

For the second year running, an important solar energy workshop was organized by the UK Branch of the International Solar Energy Society (ISES), in cooperation with the Commission of the European Communities (CEC), on the thermal application of solar energy in building design The workshop was held on the campus of the Birmingham University, which has for many years been at the forefront of solar energy R&D and demonstration in the UK and therefore provided an excellent venue for participants from many European countries and industries

The list of speakers was impressive, contributions being made from amongst others, Italy, Belgium, Sweden and Germany The discussion was particularly stimulated by the presence of many representatives from the building industry

The majority of the presentations concerned projects supported financially by the European Community in the framework of the demonstration programme It was encouraging to see that a number of these projects represent the sharp end of solar energy technology and it was interesting to note the influence they have on the perception by industry of the future development of solar energy

The workshop also covered the various applications of well-known computer models in architectural thermal design and, moreover, attempted to identify the non-technical barriers to solar energy developments The event was considered to be successful both in increasing the awareness of solar energy potential and in furthering the application of developed technologies Proceedings have

ı published and are available from ISES, Internatio- Solar Energy Society, 19 Albermarle Street, London X 3HA It is hoped that a similar event will be organ- l in 1986

rkshop on extraction pumps of geothermal waters eaux, France — 26 March 1985)

e workshop was arranged in cooperation with the pro- contractor, the 'Syndicat Mixte pour la Géo- rmie à Meaux'. Over 40 participants, representing all mmunity Member States, except Luxembourg, Ireland l Greece, attended

this town, which is very well situated over the geother- l reservoir of the Paris Basin, the most important geo- rmal operation in France has been realized,[1] four pairs wells (doublets) are currently being exploited for the trict heating of some 15 000 equivalent dwellings, sav- 19 000 toe per year In the production well of one of ese doublets, a new concept of submerged turbo-pump it, under a Community demonstration project contract E 456/83), is successfully operating The objective of e workshop was to ensure that as many concerned en- ies as possible in the Community were fully informed out this important development and to exchange in- rmation on the general aspects of geothermal pumping

he prototype geothermal extraction pump, developed y Ets Pompes Guinard, is especially suited to operate in ot and corrosive environments and is intended to replace e various not very satisfactory, traditional pumps (the lectro-submersible and the vertical long shaft pump) which are in current use The complete pumping system onsists of a turbo pump in the borehole, a second sur- ace feed pump coupled with a booster, and a static fre- uency convertor The submerged pump located in the vell pumping chamber is driven by the submerged tur- ine and therefore needs no electric cables or motors The urbine component is driven by the surface electric pump using as a hydraulic fluid the same geothermal fluid to be pumped up for district heating The test results have been very promising and are even somewhat better than the re- quired specifications The major advantages of the system are

(i) reliability (no submerged electrical equipment, long life hydrostatic bearings),

(ii) reduced dimensions,

(iii) longer life cycle for the whole unit,

(iv) easy installation and flexible accommodation of va- riations in flow-rates,

(v) reduced maintenance and replacement costs

There are many geothermal projects in Europe and else- where operating in difficult physical/chemical environ- ments and thus a market for pump equipment of this type already exists

The workshop was very successful both in interesting po- tential users of this pumping system and in achieving a valuable exchange of information on pumping problems

Workshop on electricity production from blast-furnace gas (Duisburg, Germany — 14 June 1985)

European iron and steel company representatives atten- ded a workshop at Duisburg to discuss an energy saving demonstration project undertaken by Thyssen Stahl AG with the financial aid of the European Community

The Thyssen steelworks at Duisburg has developed and demonstrated a project consisting of the production of electricity from the expansion energy of the gas from its blast-furnaces In a modern iron and steelworks, the air sent to the base of the blast furnace is compressed to a high pressure to improve the efficiency of the ore reduc- tion On exiting, the exhaust gas pressure is almost double that of the outside atmospheric pressure To get the ma- ximum benefit from this gas, which is partially combusti- ble, it is necessary to operate a pressure recovery system

Certain steelworks have already equiped the exhaust gas systems of their blast furnaces with a turbine alternator unit and produce electricity in this fashion But until now the output was relatively modest and represented less than 10% of the potential energy recoverable from the pressure drop The difficulties encountered in obtaining higher outputs related to the resistance of the turbine blades to corrosion from the exhaust gas, which is loaded with oxide dust and at high temperature As a result of an efficient gas purification system and a particularly corro- sion resistant turbine, Thyssen have succeeded in raising the output of this operation by more than 90%, or 30 kWh of electricity per tonne of steel produced, which in turn is equivalent to an energy saving of 7 800 toe per annum

The results have shown that the installation is most cer- tainly profitable as a result of the additional electricity in- jected into the plants network At the workshop, the rep- resentatives of 11 major iron and steel manufacturers

[1] Indeed, the town's achievements form part of the French pavillon in the Tsukuba international exhibition

visited the installation and were able to question the operators on all the technical and economic viability issues of the plant The undertaking of this type of workshop indicates the Commission's concern to see that successful energy saving demonstration projects are repeated Thyssen Stahl AG intend to equip two further blast furnaces with the same technology The Commission estimates that if the process were utilized more widely among European steelmakers, a saving of approximately 200 000 toe per annum would be achievable in the medium term

The companies represented at the workshop were British Steel Corporation — Cockerill-Sambre — Hoesch — Krupp Stahl — Mannesmannrohren-Werke — Nuova Italsider — Peine Salzgitter — Sidmar — Solmer — Usinor and Voest-Alpine. The demonstration project was project EE/246/81/D and further information may be obtained from the Commission or from Thyssen Stahl AG

Council resolution on the rational use of energy in the building sector

The Council recently demonstrated the importance it attaches to the rational use of energy in the building sector by adopting a resolution[1] on the subject

In this resolution the Council

(i) welcomes the Commission's initiative, designed to supplement efforts already undertaken in the Member States ,

(ii) reaffirms the importance of a detailed examination at Community level of definitions concerning standardized methods of measuring the thermal performance of buildings ,

(iii) notes the wisdom of a more detailed study of ways and means of improving thermal performance when existing buildings are renovated,

(iv) emphasizes the importance of the regulations in force and, if necessary, of the introduction or reinforcement of such regulations,

(v) stresses the need to continue research/development and demonstration efforts ’

This resolution is the response to a Commission communication[2] which reports the following findings

(i) the energy saving potential in the building sector is 75 million toe/year by 1995 In other words, it should be possible to reduce energy consumption in this sector by some 30% within about 10 years,

(ii) this sector is the heaviest consumer of energy, ranking before industry and transport,

(iii) although per capita consumption fell by 13 6% from 1979 to 1982, the overall energy saving potential i far from being achieved

Much therefore remains to be done most Member State have been making considerable efforts for some years, but the results are very variable and sometimes minimal

The need is greater than ever for coordinated action and a joint effort Ideas, experiences and resources must be pooled, the best advantage must be taken of measures already carried out and human and especially financial resources must be applied to the best possible effect

The guidelines for action are set out under several head

(i) thermal auditing of buildings,

(ii) technical improvements,

(iii) regulatory requirements,

(iv) optimum use of funds,

(v) user information and behaviour

The Commission has already started work in three field

(i) examination of questions concerning notification o the energy efficiency of buildings by a certificatio process,

(ii) assessment of the pilot projects already carried out i some Member States for the energy rehabilitation o existing buildings after thermal auditing,

(iii) preparation of a specific 'RUE, building secto Eurocode that will contain the technical rules for th methods of calculating the energy requirements o buildings, recommend harmonized test and monito ring standards and specifications and offer standa solutions that take account of different situations

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[1] Council resolution of 15 March 1985, Official Journal C 78, 26 3 1985

[2] 'Towards a European policy for the rational use of energy in the bui ing sector', COM(843) 614 of 13 November 1984

[3] See 'Comparison of energy saving programmes of EC Member Stat COM(84) 36 of 2 February 1984 This Commission communicati describes the measures taken and points out certain gaps

Rational use of energy in health care establishments

Health care establishments are a building subsector with highly complex installations. It is no exaggeration to say that these buildings exhibit virtually all the energy problems of the sector combined

There are more than 15 000 health care establishments in the Community with about 2 5 million beds

It is difficult to estimate their energy consumption accurately depending on the country, the average ranges from 2 to 6 toe per bed occupied per year The energy bill accordingly ranges from 1 000 to 3 000 ECU/bed/year Total annual energy consumption runs at some 7 to 8 million toe, which means an energy bill of 3 500 million to 4 000 million ECU per year

Energy is not a primary concern of hospital administrators their problems are essentially the quality of care, medical staff shortages, budgets and accounts, and administration As a result, and also because the installations and equipment are so sophisticated, there is considerable overconsumption of energy On average, consumption could be reduced by some 20% through improved management and careful investment An important fact to note is that, compared with other building subsectors, the payback time for investment is fairly low at about two to three years

In other words, potential energy savings in hospitals throughout the Community is some 1 5 million toe per year

Some Member States have launched massive hospital refitting programmes, with systematic thermal auditing followed by capital expenditure

However, the Commission felt that there was a need for a guide for heads of hospital plant and maintenance departments, to alert them to the problem and inform them of the energy — and therefore financial — savings possible Many things can be done besides physical improvements to a building and its equipment efficient management and changes in the behaviour of all hospital staff can result in substantial savings

The Commission has accordingly had a manual drafted on methods of identifying ways of saving energy in health care establishments

It comprises over 200 technical data sheets covering eight fields, each data sheet showing

(i) the type of operation (description of the improvement),
(ii) probable energy gains,
(iii) comments, and
(iv) profitability assessment of the operation

As a test, a simulation exercise was run on four hospitals selected as representative on the criteria of size, age and type of construction For each establishment the study identified financially profitable operations on the basis of the technical data sheets

This methods manual is not meant to replace thermal auditing, it complements it by pointing the way to an initial investigation and assessment of possible improvements beforehand, and making sure that the improvements are maintained by sound management afterwards Good management must become a permanent concern of hospital staff

The methods manual for the rational use of energy in hospitals is available in French from the Commission's Directorate-General for Energy

Commission reaffirms support for 'Energy Bus' concept to save energy in SME

The European Commission has decided to reaffirm its support for the 'Energy Bus' concept to save energy in SME by according it 1 325 000 ECU for the period 1985-87 The 'Energy Bus' approach, first introduced to the Community in 1980 after its earlier success in Canada from 1977 onwards, is geared towards redressing the difficulties that small and medium size industrial enterprises have in gaining access to information and advice on energy saving in their own plant

The 'Energy Buses' are effectively mobile audit vehicles equipped with computers, measuring instruments, demonstration equipment and video units and staffed by a team of experienced engineers The buses visit different plants, on average for a day at atime, and produce an analysis of the plant energy use pattern and the potential for energy savings The results are presented to the plant managers The recommendations made are generally

low-cost in nature with more complicated changes identified usually involving a suggestion to contact a qualified consulting firm

By the end of 1984 about 10 500 audits had been undertaken by participating groups in Belgium, the FR of Germany, Italy, Ireland, Holland and Turkey Of this total, almost 8 000 are now stored in a common data base of the EEC Joint Research Facility at Ispra, Italy The potential energy savings identified vary between 10% and 20% of normal consumption in a plant per bus visit This is equivalent to about 130 tonnes oil equivalent (toe) per audit, or 26 000 toe per bus per year The total savings identified so far amount to not much less than one million tonnes oil equivalent

The most recent Commission decision reflects the wide acceptance of the energy bus concept by European industry The Commission intends to deepen the impact of the programme by (a) attracting participants of other Member States, (b) focusing more closely on a selected number of industrial sub-sectors with significant potential for savings, (c) maintaining the tempo of audits undertaken at about 1 500 per year and give partial financial support, and (d) conducting national and sectoral analyses of data gathered with the support of coordinators in the participating groups This programme will run for two years from October 1985 to September 1987

The programme continues to benefit from interchanges of experience with the Canadian programme under the auspices of a Memorandum of understanding between Canada and the European Communities signed in 1979 This had led to a free and full exchange of software for data accumulation, access to the respective data bases and an exchange of experience and technical improvements In the earlier part of the Community's programme Canada also provided training for the first Community energy bus crews and a demosntration bus to visit Member States

Further information on this programme may be obtained by writing to
The Commission of the European Communities

Directorate-General for Energy
Energy Bus Programme
200 rue de la Loi
B - 1049 Brussels

Electricity prices 1978-84

After a study on gas prices, the Commission has recen
issued a similar publication entitled *'Electricity pri
1978-84'*, a further step towards ensuring transparen
of consumer prices for energy

This publication is the outcome of a survey made by
Statistical Office of the European Communities in co
boration with the electricity generating and distribu
companies in some 30 cities or regions of the Co
munity

Real prices paid by each representative category of con
mer are shown in a large number of tables and grap
and the text explains how the electricity industry is or
nized and goes into tariff systems, taxation, price tren
and international price comparisons

The main conclusions may be summed up as follows

(i) there is a general rise in current prices,

(ii) prices also rose in constant terms,

(iii) small domestic consumers were relatively well p
tected,

(iv) nevertheless, electric central heating became m
expensive,

(v) prices for industrial consumers followed dive
trends in some cases the heaviest consumers su
red the largest price increases, in others it was
reverse,

(vi) price differences between countries remained wi
sometimes varying by as much as a factor of 2,

(vii) the heaviest tax burden fell on domestic consume

(viii) in most cases tax-exclusive prices rose less th
prices inclusive of all taxes — in other words, ta
were increased,

(ix) price trends were strongly influenced by ta
systems (whether or not indexed),

(x) electricity prices increasingly depended on the ti
of supply, varying according to the season and
time of day,

(xi) the position of electricity improved relative to t
of gas

This publication is available in English, French, Germ
and Italian and may be obtained from the sales offices
ted on the inside back cover, or from

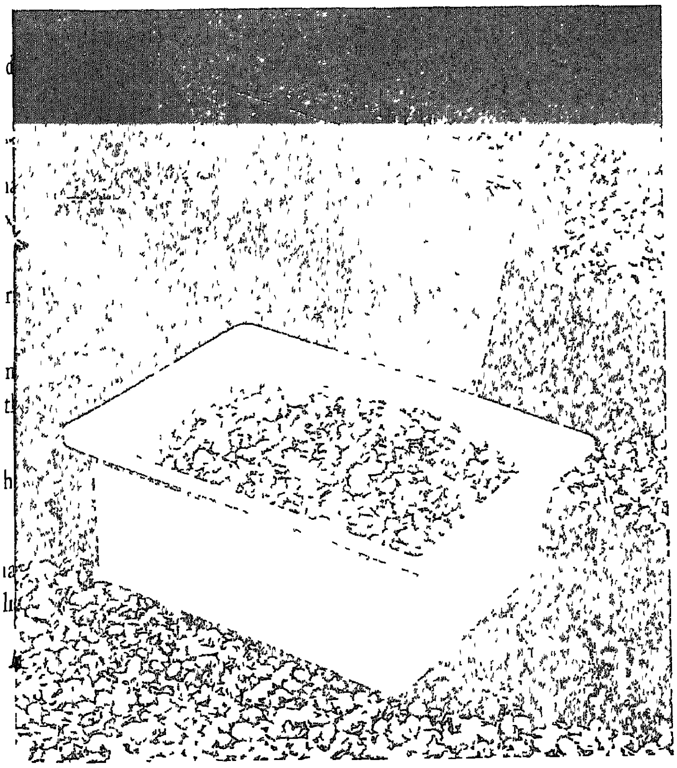
Office for Official Publications of the European
Communities,
5 rue du Commerce
L - 2985 Luxembourg

nergy demonstration programme: iomass and energy from waste

, until the end of 1984 the Commission had given suprt to 102 demonstration projects dealing with the use biomass or waste (the 1985 selection is still under .y) Over the last few years, the nature of the proposals s changed In the past most interest was shown in the oduction and use of **biogas**, while in 1984 increasing terest was being shown in the production of gas and ar through **gasification** and **pyrolysis**, and in the pro- ;ction and use of **refuse-derived fuels** (RDF)

iere is also renewed interest in **composting**, a technique hich some years ago seemed to have been fully develo- 'd and to be of such marginal interest that, on its own, it as hardly a candidate for technical innovation

is now apparent that composting deserves careful reapaisal This subject has revived, partly for environmenl reasons, but also because it is clear that it can be consi- 'rably improved from both the technological and econo- ;c points of view In this respect it is worth underlining e usefulness of the composting process for treatment of e organic fraction as a means of reducing the cost of the eatment and disposal of urban waste



finished plastic products

Anaerobic digestion processes have been successfully applied in the industry field Production and utilization of biogas at the farm level is still questionable unless expert maintenance/repair services are readily available

Production of **ethanol** is receiving increasing interest in view of its utilization as an additive in fuel

Another topic still of considerable interest is the sorting **of urban waste.** Although more plants are now using this technique in Europe and much technological progress has been made, there is still scope for projects to demonstrate integrated waste treatment methods with the aim of saving costs and energy by improving the production/collection/treatment/recycling chain

The Intradel project

The demonstration project carried out as early as 1979 by Intradel-Liège, Belgium, under the Community programme is a good example of energy recovery from plastic waste (Project No EE/192/79)

Obtaining a 'plastic concentrate'

The most economical process for obtaining plastics of an acceptable quality is still the automatic sorting of raw refuse After several years of industrial tests, Esdex in the Netherlands has developed an efficient process which is working satisfactorily at Zoetermeer, The Hague

Flexible plastic sheet and film are baled after separation from a paper and plastic mix and sent to the Intradel plant Nearly 60% of plastic waste in Belgium is dealt with in this way

More rigid, heavier or more bulky plastic items cannot be separated out in this way

These polymers may contain chlorine or sulphur and produce corrosive and toxic acids by combustion (by direct incineration or indirect incineration, i e burning a fuel derived from the light fraction of the waste)

Intradel has stepped up its selective collection of plastic bottles in the Liège municipal areas in collaboration with the Belgian firm GB-INNO-BM

The separate collection of plastic containers at source has several advantages

(1) the volume of waste to be collected is substantially reduced,

(ii) the derived fuel is of improved quality,

(iii) a source of good-quality plastic is obtained

The technology used

The plastic materials, either sorted automatically or collected separately, are tipped onto a vibratory feeder from which they pass to a slow shredder consisting of two parallel shafts with discs which cut the waste into pieces a few centimetres on a side, releasing any non-plastic materials and trapping unwanted hard and bulky items

The pre-treated waste is then fed into an air separator which removes heavy items (often contained in selective collections) The plastics are concentrated in a light fraction which after magnetic separation is fed into a rotary-blade grinder This reduces the plastics to 100 mm granules which are then washed, centrifuged and dried

The dry waste from rigid plastics is micronized and that from more flexible plastics is predensified

After micronization or predensification the products are stored and then mixed with additives according to customers' specifications The compound is fed into plasticizer-granulators which homogenize, plasticize and granulate the polymer compounds thus formed The granules obtained are then packaged for storage and delivery to customers for processing into finished products

Marketing

Although the granules are produced at highly competitive prices compared with new materials and industrial wastes (see table below), finding outlets for them has required a major technical and marketing effort

(Cost prices (BFR/kg)

Year	New materials[1]			Industrial waste	Intradel Compounds
	PVC	PE	PS		
1984	37	46	54	33 to 40	25

(1) PVC = Polyvinylchloride, PE = Polyethylene, PS = Polystryrene

The origin of the compounds caused some resistance among potential users, which was not overcome until trials were carried out to develop new products specifically designed for manufacture from these new plastics New market opportunities were thus opened up through collaboration between industrial users and Intradel Pl tic waste now competes with other plastics of high grade origin and with traditional materials such as woo paperboard, earthenware and so on

Further information may be obtained from Intradel, Po de Herstal, Pré Wigi, B-4400 Herstal

Solid fuel gasification

Coal gasification differs from pyrolysis, the technique which was described in a previous issue, in that it is a pro cess, not of distillation, but of the complete conversion coal into gas Earlier this century, it served not only to r lease gas supplies from dependence on coke productio but also to make pure synthesis gas available to the ch mical industry With the rapidly increasing supplies ar steadily falling prices of petrochemical feedstocks in t 1950s and 1960s, however, the chemical industry a most district gas works changed over to the gasificati of oil and naphtha, which made gas production cheap and technically simpler the gasification of coal l ground and this tendency increased with the discovery plentiful supplies of natural gas in the 1960s and 197 Now, however, the further development of coal gasific tion is being pursued both by some Member States and an activity part-financed by the Community Outside t Community, only the United States and Japan have sig ficant programmes of support for this technology

Surface gasification of solid fuels can be carried out b variety of techniques, which mostly operate by bring these fuels (chiefly coal, but also lignite) into contact w a mixture of air (or oxygen) and steam The oxygen in air or pure oxygen is used for the purpose of burning p of the fuel (20-30%) in order to maintain a good react temperature at this temperature the steam reacts with solid fuel, and synthesis gas is produced, a mixture of riable proportions of carbon monoxide and hydrog from which many other gaseous or liquid compounds methanol) can be synthesized It can, of course, be burr simply in order to provide heat (but with a low or r dium calorific value), or to supply a gas turbine for el tricity generation Its further transformation into m hane produces SNG (substitute natural gas), used such

The Community's demonstration programme relating gasification and liquefaction of solid fuels began in 19 It is a natural extension of the research which has b

ducted under Article 55 of the Coal and Steel Treaty many years After an initial evaluation in 1982, the gramme was extended to include industrial pilot pro-ts on a smaller scale and at less cost than that of de-nstration projects proper

nder the 1983-85 programme, grants of financial sup-rt of up to 49% of the total eligible cost of projects are de, subject to a clause whereby up to 50% of the assis-nce received is repayable in the event of commercial ccess in the case of demonstration projects (but not in e case of industrial pilot projects) Feasibility studies a also qualify for Community support if no study is own or available for similar projects

1983, 1984 and 1985 invitations to submit gasifica-on projects resulted in seven acceptances for each of hese three years, with total financial support of 27 7 illion ECU granted in 1983, 20 3 million ECU in 1984 nd 20 4 million ECU in 1985 this brings the total for ommitments since 1979 to 138 3 million ECU The de-onstration or industrial pilot projects selected cover all main gasification techniques fixed bed gasification, which the gasifying agent is passed through heated coal stasis (British Gas Corporation), fluidized bed gasifica-on, in which the gasifying agent passes through a mov-g bed of smaller pieces of coal (the National Coal ard, Energy-Equipment, Labofina and Charbonnages France) and entrained bed gasification, in which the ygen blows through dust-like particles of coal in lent motion (Rheinbraun, Veba Oel and Krupp-Kop-rs) Two more specific projects are connected with the el industry the Klockner molten iron bath gasification oject and the feasibility study of the Centre de Recherches Industrielles de l'Université de Bruxelles of the gasification of coal in blast furnaces

There were also two underground gasification projects of long standing, which have now combined the French project of the 'Groupement d'étude pour la gazéification souterraine' and the Belgo-German project of the 'Institution pour le développement de la gazéification souterraine' Underground gasification involves pumping the gasifying agent down to the coal *in situ*, the resulting gases being brought to the surface via another route Underground gasification presents many difficulties and has not so far emerged beyond the stage of industrial pilot projects

The solid fuel gasification projects financed by the European Community, which are at varying stages of completion, aim at providing commercially worthwhile sources of gas for the production of chemical derivatives, for power generation and for heating The economics of solid fuels gasification are dependent, for synthesis gas, on comparisons with that produced from heavy fuel oil or natural gas and, in the case of substitute natural gas (SNG) on comparisons with natural gas itself In view of the high levels of investment required for coal gasification plants and continuing uncertainly in the general economic outlook, it is not possible to say more at present than that the production of synthesis gas and the use of coal gasification for electricity generation seem likely to be the most promising applications Further indications will emerge when the current demonstration and pilot projects are completed in a few years' time Meanwhile, the programme continues within the Community's overall strategy of reducing dependence on imported oil and ensuring a broader variety of sources of energy

Main Commission energy documents, proposals, directives in 1985

Energy policy

COM(85) 0245-02 Draft Council Resolution concerning new Community energy policy objectives for 1995 and convergence of the Member States

COM(85) 0245-01 Communication from the Commission to the Council — New Community energy objectives

COM(85) 0143 First report from the Commission to the Council and to the European Parliament on the application of Council Regulation (EEC) No 1890/84 of 26 June 1984 introducing special measures of Community interest relating to energy strategy

COM(85) 0118 Second report from the Commission to the Council and to the European Parliament on the application of Council Regulation (EEC) No 625/83 of 15 March 1983 establishing specific measures of interest relating to energy strategy (in 1983)

Solid fuels

COM(85) 0098 Memorandum concerning the implementation and execution of a coal research programme with a view to obtaining financial aid under the terms of Article 55(2) (C) of the ECSC Treaty (budgetary year 1985)

COM(85) 0061 Memorandum on the financial aids granted b
Member States to the coal industry in 1984 a
the additional financial aids granted by the M
ber States to the coal industry in 1983

Nuclear

COM(85) 0294 Commission Communication to the Council
tion to be adopted concerning the expiry o
June 1985 of the 1961 Euratom-Brazil Agree

Energy saving, alternative energies, electrici

COM(85) 0029-02 Proposal for a Council Regulation (EEC) on
promotion, by the granting of financial suppor
pilot industrial projects and demonstration
jects relating to the liquefaction and gasificatio
solid fuels

COM(85) 0029-01 Proposal for a Council Regulation (EEC) on
promotion, by the granting of financial suppor
demonstration projects relating to the exploita
of alternative energy sources and to energy sa
and the substitution of hydrocarbons